

```

Rbind_p = Vmax_Bp * Ca_p / (Km_Bp + Ca_p) - Kunb_p * CAbind_p;

# Rate of elimination of perchlorate (nmol/h).
RAelim_p = CLuP * Ca_p;

# Rate of change of perchlorate in red blood cells (nmol/h).
RRBC_p = PARBC_p * (Ca_p - CRBC_p / PRBC_p);

# Rate of change of perchlorate in the plasma (nmol/h).
RAplasma_p = QC * (Cvtotal_p - Ca_p) + RAIoral_p + Rabs_p - RAelim_p
- Rbind_p - RRBC_p;

# Rate of change of perchlorate in the rest-of-body (nmol/h).
RArob_p = Qrob * (Ca_p - Cvrob_p);

# Rate of NIS transport of perchlorate into thyroid (nmol/h).
RNISthy_p = VmaxNIS_thy_p * CthyB_p / (CthyB_p + KmNIS_p * (1.0 +
(CthyB_i + CthyB_ri) / KmNIS_i));

# Rate of passive transport of perchlorate into thyroid (nmol/h).
RPAtthy_p = PAthy_p * (CthyB_p - CthyT_p / Pthy_p);

# Rate of change of perchlorate in thyroid blood (nmol/h).
RAthyB_p = Qthy * (Ca_p - CthyB_p) - RNISthy_p - RPAtthy_p;

# Rate of change of perchlorate in thyroid tissue (nmol/h).
RAthyT_p = RNISthy_p + RPAtthy_p;

# ----- Instantaneous equilibration calculations -----
# Amounts (nmol) and concentrations (nmol/L) of free (unbound) iodide
# and radioiodide in the thyroid tissue (nmol). We assume these to be at
# pseudo-steady state, since they vary and reach steady state on a much
# faster time-scale than other system variables. Therefore, algebraic
# equations (assuming flow in = flow out) are used instead of ODEs to
# describe the amounts.
AthyT_fi = (RNISthy_i + PAthy_i * CthyB_i) / (Aremain * Kbind_i
+ PAthy_i / (VthyT * Pthy_i));
CthyT_fi = AthyT_fi / VthyT;
AthyT_fri = (RNISthy_ri + PAthy_i * CthyB_ri) / (Aremain * Kbind_i
+ PAthy_i / (VthyT * Pthy_i));
CthyT_fri = AthyT_fri / VthyT;

# Total amount (nmol) and concentration (nmol/L) of iodide and radioiodide
# in the thyroid. This equals the amount in thyroid blood + amount bound in
# thyroid tissue + amount free (unbound) in thyroid tissue.
Athy_i = AthyB_i + Abound_i + AthyT_fi;
Cthy_i = Athy_i / Vthy;

```

```

Athy_ri = AthyB_ri + Abound_ri + AthyT_fri;
Cthy_ri = Athy_ri / Vthy;

# ----- Rates of change that depend on instantaneous equilibration -----

# Rate of passive transport of iodide and radioiodide into thyroid (nmol/h).
RPAthy_i = PAthy_i * (CthyB_i - CthyT_fi / Pthy_i);
RPAthy_ri = PAthy_i * (CthyB_ri - CthyT_fri / Pthy_i);

# Rate of change of iodide and radioiodide in the thyroid blood (nmol/h).
RAthyB_i = Qthy * (Ca_i - CthyB_i) - RNISthy_i - RPAthy_i;
RAthyB_ri = Qthy * (Ca_ri - CthyB_ri) - RNISthy_ri - RPAthy_ri;

# Rate of binding of free (unbound) iodide and radioiodide in thyroid
# tissue (nmol/h).
Rbind_i = AthyT_fi * Aremain * Kbind_i;
Rbind_ri = AthyT_fri * Aremain * Kbind_i;

# Rate of change of iodide and radioiodide bound in thyroid tissue (nmol/h).
RAbound_i = Rbind_i - RioduT4 - RioduT3;
RAbound_ri = Rbind_ri - RiodurT4 - RiodurT3;

# ----- Time rates of change of state variables (ODEs) -----

# Total amount of iodide dosed (nmol).
dt(Adose_i) = Rdose_i;

# Total amount of radioiodide dosed (nmol). This equation has been modified
# from the ACSLX implementation allow for radioiodide bolus dosing to a
# stomach compartment. -- DFK 8-2-2017
dt(Adose_ri) = Rabs_ri;

# Amount of iodide in plasma (nmol).
dt(Aplasma_i) = RAplasma_i;

# Amount of radioiodide in the stomach (nmol). This state variable was
# added to allow for radioiodide bolus dosing. It was not present in the
# original ACSLX code, where bolus dosing was handled differently.
# -- DFK 8-2-2017
dt(Astom_ri) = Rstom_ri;

# Amount of radioiodide in plasma (nmol).
dt(Aplasma_ri) = RAplasma_ri;

# Total amount of iodide eliminated (nmol).
dt(Aelim_i) = RAelim_i;

```

```

# Total amount of radioiodine eliminated (nmol).
dt(Aelim_ri) = RAelim_ri;

# Amount of iodide in the rest-of-body (nmol).
dt(Arob_i) = RArrob_i;

# Amount of radioiodide in the rest-of-body (nmol).
dt(Arob_ri) = RArrob_ri;

# Amount of iodide in the thyroid blood (nmol).
dt(AthyB_i) = RAthyB_i;

# Amount of radioiodide in the thyroid blood (nmol).
dt(AthyB_ri) = RAthyB_ri;

# Total amount of radioiodide transported into thyroid (nmol). This
# includes NIS transport and passive transport.
dt(Aupthy_ri) = RNISthy_ri + RPathy_ri;

# Amount of iodide bound in thyroid tissue (nmol).
dt(Abound_i) = RAbound_i;

# Amount of radioiodide bound in thyroid tissue (nmol).
dt(Abound_ri) = RAbound_ri;

# Total amount of T4 eliminated (nmol).
dt(AelimT4) = RelimT4;

# Total amount of radio-T4 eliminated (nmol).
dt(AelimrT4) = RelimrT4;

# Amount of T4 in the volume of distribution (nmol).
dt(AT4) = RT4;

# Amount of radio-T4 in the volume of distribution (nmol).
dt(ArT4) = RrT4;

# Total amount of T3 eliminated (nmol).
dt(AelimT3) = RelimT3;

# Total amount of radio-T3 eliminated (nmol).
dt(AelimrT3) = RelimrT3;

# Amount of T3 in the volume of distribution (nmol).
dt(AT3) = RT3;

# Amount of radio-T3 in the volume of distribution (nmol).

```

```

dt(ArT3) = RrT3;

# Total amount of perchlorate ingested orally (nmol). This amount is
# assumed to go straight into the plasma (not the stomach).
dt(AIoral_p) = RAIoral_p;

# Amount of perchlorate in the stomach (nmol).
dt(Astom_p) = Rstom_p;

# Amount of perchlorate in the plasma (nmol).
dt(Aplasma_p) = RAplasma_p;

# Total amount of perchlorate eliminated (nmol).
dt(Aelim_p) = RAelim_p;

# Amount of perchlorate bound in plasma proteins (nmol).
dt(ABind_p) = RBind_p;

# Amount of perchlorate in red blood cells (nmol).
dt(ARBC_p) = RRBC_p;

# Amount of perchlorate in the rest-of-body (nmol).
dt(Arob_p) = RArab_p;

# Amount of perchlorate in thyroid blood (nmol).
dt(AthyB_p) = RAthyB_p;

# Amount of perchlorate in thyroid tissue (nmol).
dt(AthyT_p) = RAthyT_p;

# ----- Balance checks -----
# Blood flow balance. (Should be 0% at all times.)
Qbal = 100.0 * (QC - (Qthy + Qrob)) / QC;

# Volume balance. The value of "Vbal" should be constant at 100% in both
# pre-pregnancy and pregnancy. -- DFK 8-3-2017
Vtot = Vpls + VRBC + Vthy + Vrob;# Total volume (L).
Vbal = 100.0 * Vtot / BW;

# Iodide mass balance. (The value of "Mbal_i" should in most cases be a
# constant equal to the initial iodide mass in the body, but bolus
# (discrete) doses will lead to increases in the value.) -- DFK 8-3-2017
MassInput_i = Adose_i;
MassOutput_i = Aelim_i + 4.0 * AelimT4 + 3.0 * AelimT3;
MassInBody_i = Aplasma_i + Arob_i + Athy_i + 4.0 * AT4 + 3.0 * AT3;
Mbal_i = MassInBody_i + MassOutput_i - MassInput_i;

```

```
# Perchlorate mass balance. (The value of "Mbal_p" should in most cases be
# a constant equal to the initial perchlorate mass in the body, but bolus
# (discrete) doses will lead to increases in the value.) -- DFK 8-3-2017
MassInput_p = AIoral_p + Astom_p;
MassOutput_p = Aelim_p;
MassInBody_p = Aplasma_p + Abind_p + ARBC_p + Arob_p + Athy_p;
Mbal_p = MassInBody_p + MassOutput_p - MassInput_p;
}
# End of DYNAMICS.
#-----
```

End.

DYNAMIC LINK LIBRARY

64bit for Windows Server 2003

Technical File Information:

Image File Header

Signature: 00004550
Machine: AMD 64 (K8)
Number of Sections: 000b
Time Date Stamp: 59976305
Symbols Pointer: 00000000
Number of Symbols: 00000000
Size of Optional Header: 00f0
Characteristics: File is executable (i.e. no unresolved external references).
Line numbers stripped from file.
Local symbols stripped from file.
Debugging info stripped from file in .DBG file
File is a DLL.

Image Optional Header

Magic: 020b
Linker Version: 2.25
Size of Code: 00004200
Size of Initialized Data: 00002800
Size of Uninitialized Data: 00000e00
Address of Entry Point: 000013e0
Base of Code: 00001000
Image Base: 000000006d600000
Section Alignment: 00001000
File Alignment: 00000200
Operating System Version: 4.00
Image Version: 0.00
Subsystem Version: 5.02
Reserved1: 00000000
Size of Image: 00010000
Size of Headers: 00000400
Checksum: 0001565e
Subsystem: Image runs in the Windows character subsystem.
DLL Characteristics: 0000
Size of Stack Reserve: 0000000000200000
Size of Stack Commit: 00000000000001000
Size of Heap Reserve: 0000000000100000
Size of Heap Commit: 00000000000001000
Loader Flags: 00000000
Size of Data Directory: 00000010
Export Directory Virtual Address: 0000b000
Export Directory Size: 000000ad
Import Directory Virtual Address: 0000c000
Import Directory Size: 00000674
Exception Directory Virtual Address: 00008000
Exception Directory Size: 00000288

Base Relocation Table
 Virtual Address: 0000f000
Base Relocation Table Size: 0000005c
TLS Directory Virtual Address: 0000e020
TLS Directory Size: 00000028

Export Table

<i>Name:</i>	bbdr_model.dll
<i>Characteristics:</i>	00000000
<i>Time Date Stamp:</i>	59976305
<i>Version:</i>	0.00
<i>Base:</i>	00000001
<i>Number of Functions:</i>	00000007
<i>Number of Names:</i>	00000007

<u>Ordinal</u>	<u>Entry Point</u>	<u>Name</u>
0000	000017c0	derivs
0001	00002be0	event
0002	00001490	getParms
0003	00001460	initforc
0004	00001430	initmod
0005	00002bd0	jac
0006	00002bf0	root

Import Table

KERNEL32.dll	
<u>Ordinal</u>	<u>Function Name</u>
00d8	DeleteCriticalSection
00f8	EnterCriticalSection
01cd	GetCurrentProcess
01ce	GetCurrentProcessId
01d2	GetCurrentThreadId
0210	GetLastError
028a	GetSystemTimeAsFileTime
02a5	GetTickCount
02f9	InitializeCriticalSection
034b	LeaveCriticalSection
03bb	QueryPerformanceCounter
0401	RtlAddFunctionTable
0402	RtlCaptureContext
0409	RtlLookupFunctionEntry
0410	RtlVirtualUnwind
049f	SetUnhandledExceptionFilter
04ac	Sleep
04ba	TerminateProcess
04c1	TlsGetValue
04ce	UnhandledExceptionFilter
04ec	VirtualProtect
04ee	VirtualQuery

msvcrt.dllOrdinal Function Name

004e	__dлонexit
0053	__iob_func
0062	__setusermatherr
007b	_amsq_exit
00cb	_errno
0149	_initterm
01b9	_lock
0262	_onexit
0332	_unlock
0406	abort
0414	calloc
0430	fprintf
0437	free
0442	fwrite
0471	malloc
0479	memcpy
0496	signal
04a9	strlen
04ac	strncmp
04cb	vfprintf

Section Table

<i>Section name:</i>	.text
<i>Virtual Size:</i>	00004010
<i>Virtual Address:</i>	00001000
<i>Size of raw data:</i>	00004200
<i>Pointer to Raw Data:</i>	00000400
<i>Pointer to Relocations:</i>	00000000
<i>Pointer to Line Numbers:</i>	00000000
<i>Number of Relocations:</i>	0000
<i>Number of Line Numbers:</i>	0000
<i>Characteristics:</i>	Section contains code Section is executable Section is readable

<i>Section name:</i>	.data
<i>Virtual Size:</i>	00000070
<i>Virtual Address:</i>	00006000
<i>Size of raw data:</i>	00000200
<i>Pointer to Raw Data:</i>	00004600
<i>Pointer to Relocations:</i>	00000000
<i>Pointer to Line Numbers:</i>	00000000
<i>Number of Relocations:</i>	0000
<i>Number of Line Numbers:</i>	0000
<i>Characteristics:</i>	Section contains initialized data Section is readable Section is writeable

Section name: .rdata
Virtual Size: 00000cb0
Virtual Address: 00007000
Size of raw data: 00000e00
Pointer to Raw Data: 00004800
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section is readable

Section name: .pdata
Virtual Size: 00000288
Virtual Address: 00008000
Size of raw data: 00000400
Pointer to Raw Data: 00005600
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section is readable

Section name: .xdata
Virtual Size: 00000264
Virtual Address: 00009000
Size of raw data: 00000400
Pointer to Raw Data: 00005a00
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section is readable

Section name: .bss
Virtual Size: 00000c80
Virtual Address: 0000a000
Size of raw data: 00000000
Pointer to Raw Data: 00000000
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains uninitialized data
Section is readable
Section is writeable

Section name: .edata
Virtual Size: 000000ad
Virtual Address: 0000b000
Size of raw data: 00000200
Pointer to Raw Data: 00005e00
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section is readable

Section name: .idata
Virtual Size: 00000674
Virtual Address: 0000c000
Size of raw data: 00000800
Pointer to Raw Data: 00006000
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section is readable
Section is writeable

Section name: .CRT
Virtual Size: 00000058
Virtual Address: 0000d000
Size of raw data: 00000200
Pointer to Raw Data: 00006800
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section is readable
Section is writeable

Section name: .tls
Virtual Size: 00000068
Virtual Address: 0000e000
Size of raw data: 00000200
Pointer to Raw Data: 00006a00
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000

Characteristics: Section contains initialized data
Section is readable
Section is writeable

Section name: .reloc
Virtual Size: 0000005c
Virtual Address: 0000f000
Size of raw data: 00000200
Pointer to Raw Data: 00006c00
Pointer to Relocations: 00000000
Pointer to Line Numbers: 00000000
Number of Relocations: 0000
Number of Line Numbers: 0000
Characteristics: Section contains initialized data
Section can be discarded
Section is readable

Header Information

Signature: 5a4d
Last Page Size: 0090
Total Pages in File: 0003
Relocation Items: 0000
Paragraphs in Header: 0004
Minimum Extra Paragraphs: 0000
Maximum Extra Paragraphs: ffff
Initial Stack Segment: 0000
Initial Stack Pointer: 00b8
Complemented Checksum: 0000
Initial Instruction Pointer: 0000
Initial Code Segment: 0000
Relocation Table Offset: 0040
Overlay Number: 0000
Reserved: 0000 0000 0000 0000
 0000 0000 0000 0000
 0000 0000 0000 0000
 0000 0000 0000 0000
Offset to New Header: 00000080
Memory Needed: 2K

```

initParms <- function(newParms = NULL) {
  parms <- c(
    GSTART = 0.0,
    BW0 = 0.0,
    VFpls = 0.0,
    Hct0 = 0.0,
    VFthy = 0.0,
    VFthyB = 0.0,
    VFthyT = 0.0,
    VDFT40 = 0.0,
    VDFT30 = 0.0,
    QFC0 = 0.0,
    QCG = 0.0,
    QFthy0 = 0.0,
    MWI = 0.0,
    MWT4 = 0.0,
    MWT3 = 0.0,
    MWClO4 = 0.0,
    Prob_i = 0.0,
    Pthy_i = 0.0,
    Prob_p = 0.0,
    PRBC_p = 0.0,
    Pthy_p = 0.0,
    PARBCc_p = 0.0,
    Kunbc_p = 0.0,
    VmaxNISF_thy_i = 0.0,
    KmNIS_i = 0.0,
    VmaxNISF_thy_p = 0.0,
    KmNIS_p = 0.0,
    VmaxC_Bp = 0.0,
    Km_Bp = 0.0,
    Abndmax0 = 0.0,
    Kbind_i = 0.0,
    KprodT4F = 0.0,
    KprodT3F = 0.0,
    KdegT3F = 0.0,
    KdegT4F = 0.0,
    CLFuI = 0.0,
    CLFuP = 0.0,
    CLuFT4 = 0.0,
    CLuFT3 = 0.0,
    PAFthy_i = 0.0,
    PAFthy_p = 0.0,
    CT4TAR = 0.0,
    FRT40 = 0.0,
    FRT30 = 0.0,
    bT4 = 0.0,
    AobT4 = 0.0,
  )
}

```

```

TREG = 0.0,
pTSHv = 0.0,
pTSHk = 0.0,
kHCG = 0.0,
HCGv = 0.0,
TSHTAR = 0.0,
Pdoseug_i = 0.0,
Pdosemg_p = 0.0,
kabsc = 0.0,
Vpls0 = 0.0,
Vthy0 = 0.0,
QC0 = 0.0,
Qthy0 = 0.0,
Cboundmax = 0.0,
CFT4TAR = 0.0,
TSHhad_1 = 0.0,
TSHhad_2 = 0.0,
TSHhad = 0.0,
TSHCOR = 0.0,
Rdose_i = 0.0,
Pdose_p = 0.0,
dose_ri = 0.0,
eing_g = 0.0,
rdose_pg = 0.0,
t_g = 0.0,
pdose_s = 0.0,
kabs = 0.0,
KdegT4 = 0.0,
KdegT3 = 0.0,
CLT4 = 0.0,
CLT3 = 0.0
)
parms <- within(as.list(parms), {
GSTART = 70000.0;
BW0 = 70.0;
VFpls = 0.0359;
Hct0 = 0.394;
VFthy = 1.34e-4;
VFthyB = 0.276;
VFthyT = 0.724;
VDFT40 = 0.162;
VDFT30 = 0.603;
QFC0 = 13.378;
QCG = 141.4;
QFthy0 = 0.015;
MWI = 126.9;
MWT4 = 776.87;
MWT3 = 650.98;
}
)
```

```
MWClo4 = 99.45;
Prob_i = 0.243;
Pthy_i = 0.15;
Prob_p = 0.558;
PRBC_p = 0.8;
Pthy_p = 0.13;
PARBCC_p = 10.0;
KunbC_p = 0.03;
VmaxNISF_thy_i = 3800;
KmNIS_i = 3.15e4;
VmaxNISF_thy_p = 650;
KmNIS_p = 603.32;
VmaxC_Bp = 5.9;
Km_Bp = 181;
Abndmax0 = 17.0e6;
Kbind_i = 0.2232;
KprodT4F = 2.45e-6;
KprodT3F = 7.62e-7;
KdegT3F = 1.63e-3;
KdegT4F = 1.9e-4;
CLFuI = 0.06;
CLFuP = 0.05;
CLuFT4 = 0.001;
CLuFT3 = 0.0027;
PAFthy_i = 1.0e-4;
PAFthy_p = 1.0e-4;
CT4TAR = 111.8;
FRT40 = 1.52e-4;
FRT30 = 0.00279;
bT4 = 0.01845;
AobT4 = -0.0778;
TREG = 1.0;
pTSHv = 1.0;
pTSHk = 1.0;
KHCG = 0.00354;
HCGv = 1;
TSHTAR = 1.36;
Pdoseug_i = 0.0;
Pdosemg_p = 0;
kabsc = 800;
Vpls0 = 0.0;
Vthy0 = 0.0;
QC0 = 0.0;
Qthy0 = 0.0;
Cboundmax = 0.0;
CFT4TAR = 0.0;
TSHhad_1 = 0.0;
TSHhad_2 = 0.0;
```

```

TSHhad = 0.0;
TSHCOR = 0.0;
Rdose_i = 0.0;
Pdose_p = 0.0;
dose_ri = 0.0;
eing_g = 0.0;
rdose_pg = 0.0;
t_g = 0.0;
pdose_s = 0.0;
kabs = 0.0;
KdegT4 = 0.0;
KdegT3 = 0.0;
CLT4 = 0.0;
CLT3 = 0.0;
})
if (!is.null(newParms)) {
  if (!all(names(newParms) %in% c(names(parms)))) {
    stop("illegal parameter name")
  }
}
if (!is.null(newParms))
  parms[names(newParms)] <- newParms
out <- .C("getParms", as.double(parms),
          out=double(length(parms)),
          as.integer(length(parms)))$out
names(out) <- names(parms)
out
}

```

```

Outputs <- c(
  "GA",
  "BW",
  "Ca_i",
  "Crob_i",
  "Cvrob_i",
  "CthyB_i",
  "Cvtotal_i",
  "CthyT_fi",
  "Cthy_i",
  "Athy_i",
  "Ca_ri",
  "Crob_ri",
  "Cvrob_ri",
  "CthyB_ri",
  "Cvtotal_ri",
  "CthyT_fri",
  "Cthy_ri",
  "Athy_ri",

```

```

"CT4",
"CfT4",
"CrT4",
"CT3",
"CfT3",
"CrT3",
"Ca_p",
"CAbind_p",
"CATot_p",
"CRBC_p",
"CrOb_p",
"Cvrob_p",
"CthyB_p",
"CthyT_p",
"Cthy_p",
"Cvtotal_p",
"VDT4",
"VDT3",
"vpls",
"VthyB",
"VthyT",
"Vrob",
"CLuI",
"PAthy_i",
"TSH",
"hCG",
"VmaxNIS_thy_i",
"Aboundmax",
"Qthy",
"Qbal",
"Vbal",
"Mbal_i",
"Mbal_p"
)

```

```

initStates <- function(parms, newStates = NULL) {
  Y <- c(
    Adose_i = 0.0,
    Adose_ri = 0.0,
    Astom_ri = 0.0,
    Aplasma_i = 0.0,
    Aplasma_ri = 0.0,
    Aelim_i = 0.0,
    Aelim_ri = 0.0,
    Arob_i = 0.0,
    Arob_ri = 0.0,
    AthyB_i = 0.0,
    AthyB_ri = 0.0,
    
```

```

Aupthy_ri = 0.0,
Abound_i = 0.0,
Abound_ri = 0.0,
AelimT4 = 0.0,
AelimrT4 = 0.0,
AT4 = 0.0,
ArT4 = 0.0,
AelimT3 = 0.0,
AelimrT3 = 0.0,
AT3 = 0.0,
ArT3 = 0.0,
AIoral_p = 0.0,
Astom_p = 0.0,
Aplasma_p = 0.0,
Aelim_p = 0.0,
Abind_p = 0.0,
ARBC_p = 0.0,
Arob_p = 0.0,
AthyB_p = 0.0,
AthyT_p = 0.0
)
Y <- within(as.list(parms), {
  Y["Adose_i"] <- 0.0
  Y["Adose_ri"] <- 0.0
  Y["Astom_ri"] <- 0.0
  Y["Aplasma_i"] <- 0.0
  Y["Aplasma_ri"] <- 0.0
  Y["Aelim_i"] <- 0.0
  Y["Aelim_ri"] <- 0.0
  Y["Arob_i"] <- 0.0
  Y["Arob_ri"] <- 0.0
  Y["AthyB_i"] <- 0.0
  Y["AthyB_ri"] <- 0.0
  Y["Aupthy_ri"] <- 0.0

  Y["Abound_i"] <- 0.0
  Y["Abound_ri"] <- 0.0
  Y["AelimT4"] <- 0.0
  Y["AelimrT4"] <- 0.0
  Y["AT4"] <- 0.0
  Y["ArT4"] <- 0.0
  Y["AelimT3"] <- 0.0
  Y["AelimrT3"] <- 0.0
  Y["AT3"] <- 0.0
  Y["ArT3"] <- 0.0
  Y["AIoral_p"] <- 0.0
  Y["Astom_p"] <- 0.0
  Y["Aplasma_p"] <- 0.0
}
)

```

```
Y["Aelim_p"] <- 0.0
Y["Abind_p"] <- 0.0
Y["ARBC_p"] <- 0.0
Y["Arob_p"] <- 0.0
Y["AthyB_p"] <- 0.0
Y["AthyT_p"] <- 0.0

})$Y

if (!is.null(newStates)) {
  if (!all(names(newStates) %in% c(names(Y)))) {
    stop("illegal state variable name in newStates")
  }
  Y[names(newStates)] <- newStates
}
Y
```

```
#-----  
# bbdr.model  
  
# A biologically-based dose response model for perchlorate, iodide, and thyroid  
# hormones in a human adult female prior to conception and during the first  
# trimester of pregnancy.  
  
#  
# The model was translated from the ACSLX model specification language ("*.csl")  
# to the MCSim model specification language ("*.model") in July-August 2017 by  
# Dustin Kapraun (U.S. EPA).  
  
#  
# This model was created in February-August 2017 by Paul Schlosser (U.S. EPA)  
# in consultation with Jeff Fisher (U.S. FDA), Teresa Leavens (PK Consultant),  
# and Dustin Kapraun (U.S. EPA). It is based upon a BBDR model for a lactating  
# mother that was developed by Jeff Fisher (U.S. FDA), Annie Lumen (U.S. FDA),  
# Eva McLanahan (U.S. EPA, currently CDC), Paul Schlosser (U.S. EPA), and  
# Teresa Leavens (PK Consultant).  
  
#  
# This model describes maternal iodide, thyroid hormone, and perchlorate  
# kinetics and dynamics prior to and up through the first trimester of  
# pregnancy. A variable pre-pregnancy simulation time (GSTART) allows the  
# system to reach steady state prior to pregnancy. The model does not include  
# explicit fetal or placental compartments because it is focused on maternal  
# predictions. The fetus and placenta mass and blood flow are included in the  
# "rest-of-body" tissue group.  
  
#  
# Specific changes are noted in comments with initials "PMS" for Paul  
# Schlosser.  
  
#  
# Primary model units are nmol, L, h; however, units for input parameters vary  
# as indicated in comments.  
  
#  
# Specific changes and comments during translation from ACSLX to MCSim are  
# indicated by initials "DFK" for Dustin Kapraun.  
#-----
```

```
#-----  
# STATE VARIABLES for the model (for which ODEs are provided).  
  
States = {Adose_i,# Amount of iodide dosed (total) (nmol).  
Adose_ri,# ... radioiodide dosed (total) (nmol).  
Astom_ri,# ... radioiodide in the stomach (nmol). This  
# state variable added to allow for radioiodide  
# bolus dosing. -- DFK 8-2-2017  
Aplasma_i,# ... iodide in plasma (nmol).  
Aplasma_ri,# ... radioiodide in plasma (nmol).  
Aelim_i,# ... iodide eliminated (total) (nmol).
```

```

Aelim_ri,# ... radioiodide eliminated (total) (nmol).
Arob_i,# ... iodide in the rest-of-body (nmol).
Arob_ri,# ... radioiodide in the rest-of-body (nmol).
AthyB_i,# ... iodide in the thyroid blood (nmol).
AthyB_ri,# ... radioiodide in the thyroid blood (nmol).
Aupthy_ri,# ... radioiodide transported into thyroid (total)
#      (nmol).
Abound_i,# ... iodide bound in thyroid tissue (nmol).
Abound_ri,# ... radioiodide bound in thyroid tissue (nmol).
AelimT4,# ... T4 eliminated (total) (nmol).
AelimrT4,# ... radio-T4 eliminated (total) (nmol).
AT4,# ... T4 in the volume of distribution (nmol).
ArT4,# ... radio-T4 in the volume of distribution (nmol).
AelimT3,# ... T3 eliminated (total) (nmol).
AelimrT3,# ... radio-T3 eliminated (total) (nmol).
AT3,# ... T3 in the volume of distribution (nmol).
ArT3,# ... radio-T3 in the volume of distribution (nmol).
AIoral_p,# ... perchlorate ingested orally (nmol).
Astom_p,# ... perchlorate in the stomach (nmol).
Aplasma_p,# ... perchlorate in the plasma (nmol).
Aelim_p,# ... perchlorate eliminated (nmol).
Abind_p,# ... perchlorate bound in the plasma (nmol).
ARBC_p,# ... perchlorate in red blood cells (nmol).
Arob_p,# ... perchlorate in the rest-of-body (nmol).
AthyB_p,# ... perchlorate in the thyroid blood (nmol).
AthyT_p# ... perchlorate in the thyroid tissue (nmol).
};

# End of STATE VARIABLES.
#-----

```

```

#-----
# OUTPUT VARIABLES for the model (which can be obtained at any point in time
# as analytic functions of state variables, inputs, and parameters).

Outputs = {GA,# Gestational age (weeks).
BW,# Body mass (kg).
Ca_i,# Concentration of iodide in plasma (nmol/L).
Crob_i,# ... in rest-of-body (nmol/L).
Cvrob_i,# ... in veins leaving rest-of-body (nmol/L).
CthyB_i,# ... in thyroid blood (nmol/L).
Cvtotal_i,# ... in veins (average) (nmol/L).
CthyT_fi,# ... free (unbound) in thyroid tissue (nmol/L).
Cthy_i,# ... in the whole thyroid (average) (nmol/L).
Athy_i,# Total amount of iodide in the thyroid (nmol).
Ca_ri,# Concentration of radioiodide in plasma (nmol/L).
Crob_ri,# ... in rest-of-body.
Cvrob_ri,# ... in veins leaving rest-of-body.

```

```

CthyB_ri,# ... in thyroid blood.
Cvtotal_ri,# ... in veins (average) (nmol/L).
CthyT_fri,# ... free (unbound) in thyroid tissue (nmol/L).
Cthy_ri,# ... in the whole thyroid (average) (nmol/L).
Athy_ri,# Total amount of radioiodide in the thyroid (nmol).
CT4,# Concentration of T4 (nmol/L).
CfT4,# Concentration of free T4 (nmol/L).
CrT4,# Concentration of radio-T4 (nmol/L).
CT3,# Concentration of T3 (nmol/L).
CfT3,# Concentration of free T3 (nmol/L).
CrT3,# Concentration of radio-T3 (nmol/L).
Ca_p,# Concentration of perchlorate in plasma (nmol/L).
CAbind_p,# ... in plasma proteins (bound) (nmol/L).
CAtot_p,# ... in plasma and plasma proteins (nmol/L).
CRBC_p,# ... in red blood cells (nmol/L).
Crob_p,# ... in rest-of-body (nmol/L).
Cvrob_p,# ... in veins leaving rest-of-body (nmol/L).
CthyB_p,# ... in thyroid blood (nmol/L).
CthyT_p,# ... in thyroid tissue (nmol/L).
Cthy_p,# ... in the whole thyroid (average) (nmol/L).
Cvtotal_p,# ... in veins (average) (nmol/L).
VDT4,# Volume of distribution for T4 (L).
VDT3,# Volume of distribution for T3 (L).
Vpls,# Volume of plasma (L).
VthyB,# Volume of thyroid blood (L).
VthyT,# Volume of thyroid tissue (L).
Vrob,# Volume of rest-of-body (L).
CLuI,# Urinary clearance of iodide (L/h).
PAthy_i,# Permeability value for iodide in thyroid (L/h).
TSH,# Concentration of TSH (mIU/L).
hCG,# Concentration of hCG (kIU/L).
VmaxNIS_thy_i,# Maximum rate of NIS transport of iodide (nmol/h).
Aboundmax,# Maximum capacity for organified iodide in thyroid
# tissue (nmol).
Qthy,# Blood flow rate to thyroid (L/h).
Qbal,# Blood flow balance. (Should be zero.)
Vbal,# Volume balance. (Should be 100%.)
Mbal_i,# Iodide mass balance. (Should be constant.)
Mbal_p# Perchlorate mass balance. (Should be constant.)
};

# End of OUTPUT VARIABLES.
#-----

```

```

#-----
# INPUT VARIABLES for the model (which are independent of other variables, and
# which may vary in time).
Inputs = {};

```

```

# End of INPUT VARIABLES.
#-----

#-----
# PARAMETERS for the model (which are independent of time).

# Experimental parameters.
GSTART = 70000.0;# Time of conception (h).
BWO = 70.0;# Maternal body mass (kg) prior to conception.

# Fractional tissue volumes. (See "1T Model Parameters.xlsx".)
VFpls = 0.0359;# Proportion of body volume (or mass, BW) that is
# plasma. -- PMS 4-11-17
Hct0 = 0.394;# Proportion of total blood volume that is red blood
# cells during prepregnancy. -- PMS 4-11-17
VFthy = 1.34e-4;# ... thyroid.
VFthyB = 0.276;# ... thyroid blood (proportion of VFthy).
VFthyT = 0.724;# ... thyroid tissue (proportion of VFthy).
VDFT40 = 0.162;# ... non-pregnant volume of distribution for T4.
VDFT30 = 0.603;# ... non-pregnant volume of distribution for T3.
# VDT4 and VDT3 are assumed to scale with total BW but
# proportion of total BW decreases during pregnancy.

# Fractional blood flows. Non-pregnant blood flows scale as BW^0.75. A
# function for an absolute change with gestational age (GA), independent of
# body mass (BW), is applied for total cardiac output (QC) during pregnancy.
# Flow to thyroid (Qthy) is assumed to increase in proportion to volume of
# thyroid (Vthy) during pregnancy. Vthy is assumed to increase in proportion
# to total BW.
QFC0 = 13.378;# Non-pregnant cardiac output (L/hr/kg^0.75).
# Baseline value for non-pregnant women from GA = 0
# value of fit to gestation data in
# "1T Model Parameters.A.05-23-17.docx".
# -- PMS 5-23-17
QCG = 141.4;# Multiplier (L/h) for increase in QC with gestation as
# described in "1T Model Parameters.A.05-23-17.docx".
# -- PMS 5-23-17
QFthy0 = 0.015;# Proportion of blood flow to the thyroid (Leggett &
# Williams, 1995).

# Molecular weights (g/mol).
MWI = 126.9;# Iodide.
MWT4 = 776.87;# T4.
MWT3 = 650.98;# T3.
MWCLO4 = 99.45;# Perchlorate.

```

```

# Partition coefficients (no units). See "1T Model Parameters.docx" and
# "Partition coefficient calculations.xlsx". -- PMS 3-15-2017
Prob_i = 0.243;# Iodide partitioning into rest-of-body (ROB).
Pthy_i = 0.15;# Iodide partitioning into thyroid.
Prob_p = 0.558;# Perchlorate partitioning into ROB.
PRBC_p = 0.8;# Perchlorate partitioning into red blood cells during
# pregnancy (Clewell et al.). -- PMS 4-22-15
Pthy_p = 0.13;# Perchlorate partitioning into the thyroid.

# Diffusion between red blood cells and plasma (L/hr/kg^0.75). -- PMS 4-22-15
PARBCc_p = 10.0;

# Rate constant for release of protein-bound perchlorate to plasma
# (L/hr/kg^0.75). -- PMS 4-22-15
KunbC_p = 0.03;

# Kinetic parameters for iodide.
VmaxNISF_thy_i = 3800;# Vmax of NIS in thyroid (nmol/hr/kg^0.75).
KmNIS_i = 3.15e4;# Km of NIS in thyroid (nmol/L).

# Kinetic parameters for perchlorate.
VmaxNISF_thy_p = 650;# Vmax of NIS in thyroid (nmol/hr/kg^0.75).
KmNIS_p = 603.32;# Km of NIS in thyroid (nmol/L) (=6e4/MWCIO4).
VmaxC_Bp = 5.9;# Vmax for M-M binding in serum (nmol/hr/kg^0.75).
# -- PMS 4-22-15
Km_Bp = 181;# Km for M-M binding in serum (nmol/L). -- PMS 4-22-15

# Rate constants.
Abndmax0 = 17.0e6;# Maximum amount of organified iodide in pre-pregnancy
# (ng). --PMS 4-18-17
Kbind_i= 0.2232;# 2nd order organification rate (1/nmol/hr). Value is
# replaced by running "Non-pregnant SS set.m", but
# below derives nominal value. -- PMS 4-18-17
#
# Rbind_i = AthyT_fi*Aremain*Kbind_i. For the target
# euthyroid state (to match CT4tar and CT3tar), with
# iodine intake of 177 ug/d, Cbi and the net rate of
# uptake need to be 15.9 nM and 46.43 nmol/h,
# respectively. If it's assumed that at that point
# the remaining binding capacity Aremain_I =
# Cboundmax*VthyT/16 = 7874.4 nmol and the free iodine
# concentration in the thyroid (Cfi here) is at
# equilibrium with the blood, then Cfi = 2.38 nM. In
# order to then have Rbind_i equal the uptake,
# 46.43 nmol/h = (2.38 nM*0.0111 L)*(7874.4 nmol)
# *Kbind_i, so: Kbind_i = (46.43 nmol/h)/(2.338*0.0111
# *7874.4 nmol^2) = 0.2232.
KprodT4F = 2.45e-6;# First order T4 production rate (1/hr/kg^0.75).

```

```

KprodT3F = 7.62e-7;# First order T3 production rate (1/hr/kg^0.75).
# Note that KprodT4 and KprodT3 are proportional to
# BW0^0.75 during pre-pregnancy, and due to
# regulation, are independent of BW during pregnancy.
KdegT3F = 1.63e-3;# First order serum T3 degradation rate (1/hr/kg^0.75).
KdegT4F= 1.9e-4;# First order Serum T4 degradation rate (1/hr/kg^0.75).
CLFuI = 0.06;# Renal clearance rate for iodide (L/hr/kg^0.75).
CLFuP = 0.05;# Renal clearance rate for perchlorate (L/hr/kg^0.75).
# Note that CLuI & CLuP vary as BW0^0.75, then
# multiplied by a BW-independent term for changes in
# gestation.
CLupI = 0.0;# Boolean flag: set to 1 to use iodine-based
# perchlorate clearance for pregnancy or 0 to use
# GFR-based perchlorate clearance for pregnancy.
CLuFT4 = 0.001;# Renal clearance rate for T4 (L/hr/kg^0.75).
CLuFT3 = 0.0027;# Renal clearance rate for T3 (L/hr/kg^0.75).
# Note that CLT4 and CLT3 vary as BW0^0.75, but urinary
# clearance of T4 and T3 (RelimT4 and RelimT3) change
# in proportion to the free fractions of T4 & T3, which
# vary during pregnancy.

# Permeability values for thyroid, which is diffusion limited.
PAFthy_i = 1.0e-4;# Diffusion of iodide between thyroid blood and thyroid
# tissue (L/hr/kg^0.75).
PAFthy_p = 1.0e-4;# Diffusion of perchlorate between thyroid blood and
# thyroid tissue (L/hr/kg^0.75).

# Other parameters.
CT4TAR = 111.8;# Assumed target steady-state concentration of T4 in
# non-pregnant women (nmol/L).
FRT40 = 1.52e-4;# Ratio of fT4 to T4 in non-pregnant women.
FRT30 = 0.00279;# Ratio of fT3 to T3 in non-pregnant women. PMS 3-21-17
bt4 = 0.01845;# First order term for change in fT4:T4 ratio with
# gestation week.
AobT4 = -0.0778;# Ratio 2nd order term to 1st order term for change in
# fT4:T4 ratio with gestation week.
TREG = 1.0;# Boolean flag: 1 for TSH regulation, 0 to turn it off.
PTSHv = 1.0;# Sensitivity coefficient for TSH regulation effect of
# Vmax for iodine uptake.
PTSHk = 1.0;# Sensitivity coefficient for TSH regulation effect of
# kprod for T4 & T3 production.
KHCG = 0.00354;# Sensitivity for hCG-regulation effect (L/kIU).
HCGv = 1;# Variance between 3 hCG curves defined below. hCG
# value from median curve is returned when HCGv = 1.
TSHTAR = 1.36;# Target TSH for individual calibration (mIU/L).
# Regulation is neutral when TSH = TSHTAR.

# Dosing Parameters.

```

```

Pdoseug_i = 100.0;# Iodide dose rate (ug/d). -- PMS 4-1-2015
Pdosemg_p = 0;# Perchlorate dose rate (mg/kg/d).
# -----
# REMOVE radioiodide bolus dosing parameters.
# -----
# dose_ring = 0.0;# Amount of radioiodide given orally for RAIU tests
# # (ng).
# t_i = 0.0;# Simulation time (h) at which radioiodide is given.
# Tinf = 0.25;# Time for absorption of radioiodide (h).
# Rdose_ri = 0.0;# Radioiodide dosing rate (nmol/h).
# -----
# REMOVE perchlorate bolus dosing parameters.
# -----
# bdose_pg = 0.0;# Perchlorate dose to oral compartment (mg/kg/d) as
# # described in Greer et al.
# ting_g = 0.5;# Hours of each ingestion event for Greer study (ning_g
# # events/d).
# ning_g = 4.0;# Number of ingestions per day.
# fing_g = 4.0;# Number of hours between ingestion events.
# tgdose = 49000.0;# Start-time (h) for Greer study dosing.
# days_g = 14.0;# Total days of dosing in Greer study.
# bdose_ps = 0.0;# Perchlorate given in a single oral dose at tsdose
# (mg/kg/d)
# tsdose = 49000;# Simulation time (h) for single bolus.
# -----
kabsc = 800;# Scaled first order absorption constant (kg^0.25/h).

# Parameters to be computed in MODEL INITIALIZATION. The values of these
# parameters depend on values of the parameters already defined.
Vpls0 = 0.0;
Vthy0 = 0.0;
QC0 = 0.0;
Qthy0 = 0.0;
Cboundmax = 0.0;
CFT4TAR = 0.0;
TSHhad_1 = 0.0;
TSHhad_2 = 0.0;
TSHhad = 0.0;
TSHCOR = 0.0;
Rdose_i = 0.0;
Pdose_p = 0.0;
dose_ri = 0.0;
eing_g = 0.0;
rdose_pg = 0.0;
t_g = 0.0;
pdose_s = 0.0;
kabs = 0.0;
KdegT4 = 0.0;

```

```

KdegT3 = 0.0;
CLT4 = 0.0;
CLT3 = 0.0;

# End of PARAMETERS.
#-----

```

```

#-----
# MODEL INITIALIZATION section.

Initialize {
    # Assign an initial value for each state.

    Adose_i = 0.0;# Amount of iodide dosed (total) (nmol).
    Adose_ri = 0.0;# ... radioiodide dosed (total) (nmol).
    Astom_ri = 0.0;# ... radioiodide in the stomach (nmol).
    Aplasma_i = 0.0;# ... iodide in plasma (nmol).
    Aplasma_ri = 0.0;# ... radioiodide in plasma (nmol).
    Aelim_i = 0.0;# ... iodide eliminated (total) (nmol).
    Aelim_ri = 0.0;# ... radioiodide eliminated (total) (nmol).
    Arob_i = 0.0;# ... iodide in the rest-of-body (nmol).
    Arob_ri = 0.0;# ... radioiodide in the rest-of-body (nmol).
    AthyB_i = 0.0;# ... iodide in the thyroid blood (nmol).
    AthyB_ri = 0.0;# ... radioiodide in the thyroid blood (nmol).
    Aupthy_ri = 0.0;# ... radioiodide transported into thyroid (total)
    # (nmol).
    Abound_i = 0.0;# ... iodide bound in thyroid tissue (nmol).
    Abound_ri = 0.0;# ... radioiodide bound in thyroid tissue (nmol).
    AelimT4 = 0.0;# ... T4 eliminated (total) (nmol).
    AelimrT4 = 0.0;# ... radio-T4 eliminated (total) (nmol).
    AT4 = 0.0;# ... T4 in the volume of distribution (nmol).
    ArT4 = 0.0;# ... radio-T4 in the volume of distribution (nmol).
    AelimT3 = 0.0;# ... T3 eliminated (total) (nmol).
    AelimrT3 = 0.0;# ... radio-T3 eliminated (total) (nmol).
    AT3 = 0.0;# ... T3 in the volume of distribution (nmol).
    ArT3 = 0.0;# ... radio-T3 in the volume of distribution (nmol).
    AIoral_p = 0.0;# ... perchlorate ingested orally (nmol).
    Astom_p = 0.0;# ... perchlorate in the stomach (nmol).
    Aplasma_p = 0.0;# ... perchlorate in the plasma (nmol).
    Aelim_p = 0.0;# ... perchlorate eliminated (nmol).
    Abind_p = 0.0;# ... perchlorate bound in the plasma (nmol).
    ARBC_p = 0.0;# ... perchlorate in red blood cells (nmol).
    Arob_p = 0.0;# ... perchlorate in the rest-of-body (nmol).
    AthyB_p = 0.0;# ... perchlorate in the thyroid blood (nmol).
    AthyT_p= 0.0;# ... perchlorate in the thyroid tissue (nmol).

    # Volume of the plasma (L) in pre-pregnancy. Changed to be consistent with
    # VFpls value of Lumen et al. (2013) and expectation that Vpls/BW = 0.052.
}
```

```

# -- PMS 5-11-2016
Vpls0 = VFpls * BW0;

# Volume of the thyroid (L) in pre-pregnancy.
Vthy0 = VFthy * BW0;

# Cardiac output (L/h) in pre-pregnancy. This has now been made a function
# of QFC0. -- PMS 5-23-17
QC0 = QFC0 * pow(BW0, 0.75);

# Blood flow to thyroid (L/h) in pre-pregnancy.
Qthy0 = QFthy0 * QC0;

# Maximum concentration of iodide (nmol/L) that can be bound in the
# thyroid. The maximum amount of iodide (nmol) that can be bound in the
# thyroid is found by multiplying this quantity by VthyT, which varies with
# body mass (BW).
Cboundmax = Abndmax0 / (MWI * Vthy0 * VFthyT);

# Target free T4 (fT4) concentration (pmol/L).
CFT4TAR = FRT40 * CT4TAR * (1.0e3);

# TSH based on Hadlow (mIU/L). Note that the piecewise function given here
# is currently hard coded in two places in this file. -- DFK 7-26-17
TSHhad_1 = exp(1.40 + 3.40/(1.0 + exp((CFT4TAR - 7.01) / 0.971)));
TSHhad_2 = exp(5.66 / (1.0 + exp((CFT4TAR - 20.3) / 3.05)) - 3.95);
TSHhad = (CFT4TAR <= 10.7 ? TSHhad_1 : TSHhad_2);
TSHCOR = TSHTAR / TSHhad;

# Iodide dose rate (nmol/h).
Rdose_i = Pdoseug_i * (1.0e3) / (MWI * 24.0);

# Perchlorate dose rate (nmol/kg/h).
Pdose_p = Pdosemg_p * (1.0e6) / (MWClO4 * 24.0);

# -----
# REMOVE radioiodide bolus dosing logic.
# -----
# Radioiodide dose amount (nmol) for bolus doses.
# dose_ri = dose_ring / MWI;
# -----

# -----
# REMOVE perchlorate bolus dosing logic.
# -----
# Time (h) from start of day when bolus (ingestion) dosing ends.
# eing_g = ning_g * (fing_g - 1.0) + ting_g;

```

```

# Perchlorate dose rate (nmol/h) during bolus (ingestion) dosing event.
# rdose_pg = bdose_pg * BW0 * (1.0e6 / MWClO4) / (ning_g * ting_g);

# Total time (h) of Greer study dosing.
# t_g = days_g * 24.0;

# Perchlorate dose rate for bolus dosing event.
# pdose_s = bdose_ps * BW0 * 1.0e6 / MWClO4;
# -------

# First order absorption rate (1/h).
kabs = kabsc / pow(BW0, 0.25);

# First order degradation rates for T4 and T3 (1/h).
KdegT4 = KdegT4F * pow(BW0, 0.75);
KdegT3 = KdegT3F * pow(BW0, 0.75);

# Elimination rates for T4 and T3 (L/h).
CLuFT4 = CLuFT4 * pow(BW0, 0.75);
CLuFT3 = CLuFT3 * pow(BW0, 0.75);
}

# End of MODEL INITIALIZATION.
#-----

```

```

#-----
# DYNAMICS section.
Dynamics {
# ----- Time-varying quantities required for later calculations -----

# Gestational age in weeks.
GA =(t - GSTART) / (7.0 * 24.0);
GA = (GA > 0 ? GA : 0.0);# Set to zero if GA is non-positive.

# Time-varying body mass (kg). Mass increase based on analysis of DFK is
# described in "1T Model Parameters.docx". -- PMS 3-3-17
BW = BW0 + 0.0065 * (exp(0.68 * (1.0 - exp(-0.087 * GA)) / 0.087) - 1.0);

# Time-varying elimination rate for iodide (L/h).
CLuI = CLFuI * pow(BW0, 0.75) * (1.0 + 0.0703 * GA - 0.0012 * GA * GA);

# Time-varying hematocrit (fraction of blood volume) adapted from Gaohua et
# al. (2012) as described in "1T Model Parameters.docx". -- PMS 4-8-17
Hct = Hct0 * (1 - 0.001045 * GA - (2.279e-4) * GA * GA
+ (4.475e-6) * pow(GA, 3.0));

# Proportion of T3 and T4 that are free (unbound).
# THIS SECTION COULD USE COMMENTS!!! -- DFK 7-24-17

```

```

T4fun = 1.0 + 0.47 * pow(GA, 7.45) / (pow(8.8, 7.45) + pow(GA, 7.45));
fT4fun = 1.0 + bT4 * GA + bT4 * AobT4 * GA * GA;
FrconvT4 = FRT40 * fT4fun / T4fun;
FrconvT3 = FRT30 * fT4fun / T4fun;

# Amount of free T4 (nmol).
AfT4 = FrconvT4 * AT4;

# Total amount of perchlorate in the thyroid (nmol).
Athy_p = AthyB_p + AthyT_p;

# Permeability values (L/h) for thyroid, which is a diffusion-limited
# compartment.
PAthy_i= PAFthy_i * pow(BW, 0.75);# ... for iodide.
PAthy_p = PAFthy_p * pow(BW, 0.75);# ... for perchlorate.

# Human chorionic gonadotropin (hCG) level (kIU/L).
hCGc = 0.013781 * pow(GA, 4.0) - 0.48279 * pow(GA, 3.0) + 4.5866 * GA * GA
- 4.2849 * GA;
hCG = HCGv * (hCGc > 0 ? hCGc : 0.0);

# Permeability values (L/h) for RBCs, which is a diffusion-limited
# compartment. -- PMS 4-22-15
PARBC_p = PARBCc_p * pow(BW, 0.75);

# Time-varying elimination rate for perchlorate (L/h). Changes in pregnancy
# are based on GFR(pregnancy)/GFR(control).
CLuP = CLFuP * pow(BW0, 0.75) * (1.0 + 0.029 * GA - 0.0005 * GA * GA);

# ----- Volumes -----

# Time-varying volumes (L) adapted from Gachua et al. (2012) as described
# in "1T Model Parameters.docx". -- PMS 4-8-17
Vpls = Vpls0 * (1 + 0.001738 * GA + (6.971e-4) * GA * GA
- (8.893e-6) * pow(GA, 3.0));
VRBC = Vpls * Hct / (1.0 - Hct);

# Volume of thyroid (L) is assumed to vary with total body mass.
# -- PMS 4-17-17
Vthy = VFthy * BW;# Volume of whole thyroid (L).
VthyB = VFthyB * Vthy;# Volume of thyroid blood (L).
VthyT = VFthyT * Vthy;# Volume of thyroid tissue (L).

# Volume of rest-of-body (L).
Vrob = BW - Vthy - Vpls - VRBC;

# Volume of distribution for T4 and T3 (L).

```

```

VDT4 = VDFT40 * (1.0 - 0.0023 * GA) * BW;
VDT3 = VDFT30 * (1.0 - 0.0023 * GA) * BW;

# ----- Blood flow rates -----

# Blood flow rates (L/h). For cardiac output (QC), equation is described in
# "1T Model Parameters.A.05-23-17.docx". -- PMS 5-23-17
QC = QC0 + QCG * (1.0 - exp(-0.1027 * GA));
Qthy = Qthy0 * Vthy / Vthy0;# ... to thyroid.
Qrob = QC - Qthy;# ... to rest-of-body.

# ----- Concentrations -----

# Iodide concentrations (nmol/L).
Ca_i = Aplasma_i / Vpls;# Iodide in plasma.
Crob_i = Arob_i / Vrob;# ... in rest-of-body.
Cvrob_i = Crob_i / Prob_i;# ... in veins leaving rest-of-body.
CthyB_i = AthyB_i / VthyB;# ... in thyroid blood.
Cvtotal_i = (Qrob * Cvrob_i + Qthy * CthyB_i) / QC;
# More iodide concentrations can be found in the "Instantaneous
# equilibration calculations" section below.

# Radioiodide concentrations (nmol/L).
Ca_ri = Aplasma_ri / Vpls;# Radioiodide in plasma.
Crob_ri = Arob_ri / Vrob;# ... in rest-of-body.
Cvrob_ri = Crob_ri / Prob_i;# ... in veins leaving rest-of-body.
CthyB_ri = AthyB_ri / VthyB;# ... in thyroid blood.
Cvtotal_ri = (Qrob * Cvrob_ri + Qthy * CthyB_ri) / QC;

# Thyroid hormone concentrations (nmol/L).
CT4 = AT4 / VDT4;# T4 in volume of distribution.
CfT4 = AfT4 / VDT4;# Free T4 in volume of distribution.
pCfT4 = CfT4 * 1.0e3;# Ditto (pmol/L).
CrT4 = ArT4 / VDT4;# Radio-T4 in volume of distribution.
CT3 = AT3 / VDT3;# T3 in volume of distribution.
CfT3 = FrconvT3 * CT3;# Free T3 in volume of distribution.
CrT3 = ArT3 / VDT3;# Radio-T3 in volume of distribution.

# Perchlorate concentrations (nmol/L).
Ca_p = Aplasma_p / Vpls;# Perchlorate in plasma.
CAbind_p = Abind_p / Vpls;# ... in plasma proteins (bound).
CATot_p = Ca_p;# ... in plasma and plasma proteins.
CRBC_p = ARBC_p / VRBC;# ... in red blood cells.
Crob_p = Arob_p / Vrob;# ... in rest-of-body.
Cvrob_p = Crob_p / Prob_p;# ... in veins leaving rest-of-body.
CthyB_p = AthyB_p / VthyB;# ... in thyroid blood.

```

```

CthyT_p = AthyT_p / VthyT;# ... in thyroid tissue.
Cthy_p = Athy_p / Vthy;# ... in the whole thyroid (average).
Cvtotal_p = (Qrob * Cvrob_p + Qthy * CthyB_p) / QC;

# ----- Kinetic variables -----

# TSH concentration (mIU/L). Note that the piecewise function given here
# is currently hard coded in two places in this file. -- DFK 7-26-17
TSH_1 = TSHCOR * exp(1.40 + 3.40 / (1.0 + exp((pCfT4 - 7.01) / 0.971)));
TSH_2 = TSHCOR * exp(5.66 / (1.0 + exp((pCfT4 - 20.3) / 3.05)) - 3.95);
TSH = (pCfT4 <= 10.7 ? TSH_1 : TSH_2);

# Maximum rate of NIS transport of iodide into thyroid (nmol/h). Note that
# This rate varies with GA and changes in response to TSH if TREG is 1. See
# "1T Model Parameters.docx". -- PMS 3-14-17
VCHNG = 1.0 + 0.076 * GA - 0.0025 * GA * GA;
TREGv = 1.0 - TREG + TREG * pow((TSH / TSHTAR), pTSHv);
VmaxNIS_thy_i = VmaxNISF_thy_i * pow(BW, 0.75) * VCHNG * TREGv;

# First order production rates for T4 and T3 (1/h).
HCGREG = 1.0 + hCG * khCG;
TREGk = 1.0 - TREG + TREG * pow((TSH / TSHTAR), pTSHk);
KprodT4 = KprodT4F * pow(BW0, 0.75) * HCGREG * TREGk;
KprodT3 = KprodT3F * pow(BW0, 0.75) * HCGREG * TREGk;

# Maximum rate of Michaelis-Menten binding of perchlorate to plasma
# proteins (nmol/h). -- PMS 4-22-15
Vmax_Bp= VmaxC_Bp * pow(BW, 0.75);

# Maximum rate of NIS transport of perchlorate into thyroid (nmol/h).
VmaxNIS_thy_p = VmaxNISF_thy_p * pow(BW, 0.75) * VCHNG * TREGv;

# First order release of perchlorate from plasma proteins (L/hr).
# -- PMS 4-22-15
Kunb_p = KunbC_p * pow(BW, 0.75);

# ----- Organified thyroid iodide variables -----

# Maximum capacity for organified iodide in thyroid tissue (nmol).
Aboundmax = Cboundmax * VthyT;

# Amount of unused capacity for organified iodide in thyroid tissue (nmol).
Aremain = Aboundmax - (Abound_i + Abound_ri);

# ----- Rates of change -----

```

```

# Rate of change of T4 and radio-T4 due to degradation (nmol/h).
RdegT4 = KdegT4 * AT4;
RdegrT4 = KdegT4 * ArT4;

# Rate of change of iodide produced by T4 degradation and radioiodide
# produced by radio-T4 degradation (nmol/h). We assume half of this rate is
# due to complete degradationn of T4, which produces 4 units of iodide per
# unit of T4. We assume the other half of this rate is due to conversion of
# T4 to T3, which produces 1 unit of iodide per unit of T4. Thus, on
# average, degradation produces 2.5 units of iodide per unit of T4.
RdeiodT4 = 2.5 * RdegT4;# = 0.5 * (4.0 * RdegT4 + 1.0 * RdegT4)
RdeiodrT4 = 2.5 * RdegrT4;

# Rate of change of T3 and radio-T3 due to degradation (nmol/h).
RdegT3 = KdegT3 * AT3;
RdegrT3 = KdegT3 * ArT3;

# Rate of change of iodide produced by T3 degradation (nmol/h) and
# radioiodide produced by radio-T3 degradation. Three units
# of iodide are produced per unit of T3.
RdeiodT3 = 3.0 * RdegT3;
RdeiodrT3 = 3.0 * RdegrT3;

# Rate of renal elimination of iodide and radioiodide (nmol/h).
RAelim_i = CLuI * Ca_i;
RAelim_ri = CLuI * Ca_ri;

# Rate of change of radioiodide in stomach (nmol/h). This functionality
# was added to allow for radioiodide bolus dosing. -- DFK 8-2-2017
Rabs_ri = kabs * Astom_ri;
Rstom_ri = -Rabs_ri;

# Rate of change of iodide and radioiodide in plasma (nmol/h). Term for
# rate of absorption (from stomach) has been added to RAplasma_ri.
# -- DFK 8-2-2017
RAplasma_i = QC * (Cvtotal_i - Ca_i) + Rdose_i + RdeiodT4 + RdeiodT3
- RAelim_i;
RAplasma_ri = QC * (Cvtotal_ri - Ca_ri) + Rabs_ri + RdeiodrT4 + RdeiodrT3
- RAelim_ri;

# Rate of change of iodide and radioiodide in rest-of-body (nmol/h).
RArob_i = Qrob * (Ca_i - Cvrob_i);
RArob_ri = Qrob * (Ca_ri - Cvrob_ri);

# Rate of NIS transport of iodide and radioiodide into thyroid (nmol/h).
RNISThy_i = VmaxNIS_thy_i * CthyB_i / (CthyB_i + CthyB_ri
+ KmNIS_i * (1.0 + CthyB_p / KmNIS_p));

```

```

RNISthy_ri = VmaxNIS_thy_i * CthyB_ri / (CthyB_i + CthyB_ri
+ KmNIS_i * (1.0 + CthyB_p / KmNIS_p));

# Rate of production of T4 and radio-T4 (nmol/h).
RprodT4 = KprodT4 * Abound_i;
RprodrtT4 = KprodT4 * Abound_ri;

# Rate of iodide usage for the production of T4 (nmol/h). Producing 1 mol
# of T4 requires 4 mol of iodide.
RioduT4 = 4.0 * RprodT4;
RiodurT4 = 4.0 * RprodrtT4;

# Rate of production of T3 and radio-T3 (nmol/h).
RprodT3 = KprodT3 * Abound_i;
RprodrtT3 = KprodT3 * Abound_ri;

# Rate of iodide usage for the production of T4 (nmol/h). Producing 1 mol
# of T3 requires 3 mol of iodide.
RioduT3 = 3.0 * RprodT3;
RiodurT3 = 3.0 * RprodrtT3;

# Rate of elimination of T4 and radio-T4 (nmol/h).
RelimT4 = CLT4 * CT4 * FrconvT4 / FRT40;
RelimrtT4 = CLT4 * CrT4 * FrconvT4 / FRT40;

# Rate of change of T4 and radio-T4 in the volume of distribution (nmol/h).
RT4 = RprodT4 - RdegT4 - RelimT4;
RrT4 = RprodrtT4 - RdegrT4 - RelimrtT4;

# Rate of elimination of T3 and radio-T3 (nmol/h).
RelimT3 = CLT3 * CT3 * FrconvT3 / FRT30;
RelimrtT3 = CLT3 * CrT3 * FrconvT3 / FRT30;

# Rate of change of T3 and radio-T3 in the volume of distribution (nmol/h).
RT3 = RprodT3 + 0.5 * RdegT4 - RdegT3 - RelimT3;
RrT3 = RprodrtT3 + 0.5 * RdegrT4 - RdegrT3 - RelimrtT3;

# Rate of ingestion of perchlorate (nmol/h). "Ingested" perchlorate is
# assumed to go straight into the plasma (not the stomach).
RAIoral_p = Pdose_p * BW;

# Rate of change of perchlorate in stomach (nmol/h).
Rabs_p = kabs * Astom_p;
Rstom_p = -Rabs_p;

# Rate binding to plasma proteins of perchlorate (nmol/h).
Rbind_p = Vmax_Bp * Ca_p / (Km_Bp + Ca_p) - Kunb_p * CABind_p;

```

```

# Rate of elimination of perchlorate (nmol/h).
RAelim_p = CLuP * Ca_p;

# Rate of change of perchlorate in red blood cells (nmol/h).
RRBC_p = PARBC_p * (Ca_p - CRBC_p / PRBC_p);

# Rate of change of perchlorate in the plasma (nmol/h).
RAplasma_p = QC * (Cvtotal_p - Ca_p) + RAIoral_p + Rabs_p - RAelim_p
- Rbind_p - RRBC_p;

# Rate of change of perchlorate in the rest-of-body (nmol/h).
RArob_p = Qrob * (Ca_p - Cvrob_p);

# Rate of NIS transport of perchlorate into thyroid (nmol/h).
RNISThy_p = VmaxNIS_thy_p * CthyB_p / (CthyB_p + KmNIS_p * (1.0 +
(CthyB_i + CthyB_ri) / KmNIS_i));

# Rate of passive transport of perchlorate into thyroid (nmol/h).
RPAthy_p = PAthy_p * (CthyB_p - CthyT_p / Pthy_p);

# Rate of change of perchlorate in thyroid blood (nmol/h).
RAthyB_p = Qthy * (Ca_p - CthyB_p) - RNISThy_p - RPAthy_p;

# Rate of change of perchlorate in thyroid tissue (nmol/h).
RAthyT_p = RNISThy_p + RPAthy_p;

# ----- Instantaneous equilibration calculations -----

# Amounts (nmol) and concentrations (nmol/L) of free (unbound) iodide and
# radioiodide in the thyroid tissue (nmol). We assume instantaneous
# equilibration, and therefore do not use ODEs to describe the amounts.
AthyT_fi = (RNISThy_i + PAthy_i * CthyB_i) / (Aremain * Kbind_i
+ PAthy_i / (VthyT * Pthy_i));
CthyT_fi = AthyT_fi / VthyT;
AthyT_fri = (RNISThy_ri + PAthy_i * CthyB_ri) / (Aremain * Kbind_i
+ PAthy_i / (VthyT * Pthy_i));
CthyT_fri = AthyT_fri / VthyT;

# Total amount (nmol) and concentration (nmol/L) of iodide and radioiodide
# in the thyroid. This equals the amount in thyroid blood + amount bound in
# thyroid tissue + amount free (unbound) in thyroid tissue.
Athy_i = AthyB_i + Abound_i + AthyT_fi;
Cthy_i = Athy_i / Vthy;
Athy_ri = AthyB_ri + Abound_ri + AthyT_fri;
Cthy_ri = Athy_ri / Vthy;

# ----- Rates of change that depend on instantaneous equilibration -----

```

```

# Rate of passive transport of iodide and radioiodide into thyroid (nmol/h).
RPAthy_i = PAthy_i * (CthyB_i - CthyT_fi / Pthy_i);
RPAthy_ri = PAthy_i * (CthyB_ri - CthyT_fri / Pthy_i);

# Rate of change of iodide and radioiodide in the thyroid blood (nmol/h).
RAthyB_i = Qthy * (Ca_i - CthyB_i) - RNISThy_i - RPAthy_i;
RAthyB_ri = Qthy * (Ca_ri - CthyB_ri) - RNISThy_ri - RPAthy_ri;

# Rate of binding of free (unbound) iodide and radioiodide in thyroid
# tissue (nmol/h).
Rbind_i = AthyT_fi * Aremain * Kbind_i;
Rbind_ri = AthyT_fri * Aremain * Kbind_i;

# Rate of change of iodide and radioiodide bound in thyroid tissue (nmol/h).
RAbound_i = Rbind_i - RioduT4 - RioduT3;
RAbound_ri = Rbind_ri - RiodurT4 - RiodurT3;

# ----- Time rates of change of state variables (ODEs) -----
# Total amount of iodide dosed (nmol).
dt(Adose_i) = Rdose_i;

# Total amount of radioiodide dosed (nmol). This equation has been modified
# from the ACSLX implementation allow for radioiodide bolus dosing to a
# stomach compartment. -- DFK 8-2-2017
dt(Adose_ri) = Rabs_ri;

# Amount of iodide in plasma (nmol).
dt(Aplasma_i) = RAplasma_i;

# Amount of radioiodide in the stomach (nmol). This state variable was
# added to allow for radioiodide bolus dosing. It was not present in the
# original ACSLX code, where bolus dosing was handled differently.
# -- DFK 8-2-2017
dt(Astom_ri) = Rstom_ri;

# Amount of radioiodide in plasma (nmol).
dt(Aplasma_ri) = RAplasma_ri;

# Total amount of iodide eliminated (nmol).
dt(Aelim_i) = RAelim_i;

# Total amount of radioiodide eliminated (nmol).
dt(Aelim_ri) = RAelim_ri;

# Amount of iodide in the rest-of-body (nmol).

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```

dt(Arob_i) = RArob_i;

# Amount of radioiodide in the rest-of-body (nmol).
dt(Arob_ri) = RArob_ri;

# Amount of iodide in the thyroid blood (nmol).
dt(AthyB_i) = RAthyB_i;

# Amount of radioiodide in the thyroid blood (nmol).
dt(AthyB_ri) = RAthyB_ri;

# Total amount of radioiodide transported into thyroid (nmol). This
# includes NIS transport and passive transport.
dt(Aupthy_ri) = RNISthy_ri + RPAtthy_ri;

# Amount of iodide bound in thyroid tissue (nmol).
dt(ABound_i) = RABound_i;

# Amount of radioiodide bound in thyroid tissue (nmol).
dt(ABound_ri) = RABound_ri;

# Total amount of T4 eliminated (nmol).
dt(AelimT4) = RelimT4;

# Total amount of radio-T4 eliminated (nmol).
dt(AelimrT4) = RelimrT4;

# Amount of T4 in the volume of distribution (nmol).
dt(AT4) = RT4;

# Amount of radio-T4 in the volume of distribution (nmol).
dt(ArT4) = RrT4;

# Total amount of T3 eliminated (nmol).
dt(AelimT3) = RelimT3;

# Total amount of radio-T3 eliminated (nmol).
dt(AelimrT3) = RelimrT3;

# Amount of T3 in the volume of distribution (nmol).
dt(AT3) = RT3;

# Amount of radio-T3 in the volume of distribution (nmol).
dt(ArT3) = RrT3;

# Total amount of perchlorate ingested orally (nmol). This amount is
# assumed to go straight into the plasma (not the stomach).
dt(AIoral_p) = RAIoral_p;

```

```

# Amount of perchlorate in the stomach (nmol).
dt(Astom_p) = Rstom_p;

# Amount of perchlorate in the plasma (nmol).
dt(Aplasma_p) = RAplasma_p;

# Total amount of perchlorate eliminated (nmol).
dt(Aelim_p) = RAelim_p;

# Amount of perchlorate bound in plasma proteins (nmol).
dt(Abind_p) = Rbind_p;

# Amount of perchlorate in red blood cells (nmol).
dt(ARBC_p) = RRBC_p;

# Amount of perchlorate in the rest-of-body (nmol).
dt(Arob_p) = RArob_p;

# Amount of perchlorate in thyroid blood (nmol).
dt(AthyB_p) = RAthyB_p;

# Amount of perchlorate in thyroid tissue (nmol).
dt(AthyT_p) = RAthyT_p;

# ----- Balance checks -----

# Blood flow balance. (Should be zero at all times.)
Qbal = QC - (Qthy + Qrob);

# Volume balance. The value of "Vbal" should be constant at 100% in both
# pre-pregnancy and pregnancy. -- DFK 8-3-2017
Vtot = Vpls + VRBC + Vthy + Vrob; # Total volume (L).
Vbal = 100.0 * Vtot / BW;

# Iodide mass balance. (The value of "Mbal_i" should in most cases be a
# constant equal to the initial iodide mass in the body, but bolus
# (discrete) doses will lead to increases in the value.) -- DFK 8-3-2017
MassInput_i = Adose_i;
MassOutput_i = Aelim_i + 4.0 * AelimT4 + 3.0 * AelimT3;
MassInBody_i = Aplasma_i + Arob_i + Athy_i + 4.0 * AT4 + 3.0 * AT3;
Mbal_i = MassInBody_i + MassOutput_i - MassInput_i;

# Perchlorate mass balance. (The value of "Mbal_p" should in most cases be
# a constant equal to the initial perchlorate mass in the body, but bolus
# (discrete) doses will lead to increases in the value.) -- DFK 8-3-2017
MassInput_p = AIoral_p + Astom_p;

```

```
MassOutput_p = Aelim_p;
MassInBody_p = Aplasma_p + Abind_p + ARBC_p + Arob_p + Athy_p;
Mbal_p = MassInBody_p + MassOutput_p - MassInput_p;
}
# End of DYNAMICS.
#-----
```

End.

```

#-----
# BBDRPreg_params.R
#
# Translated from "BBDRPreg_params.m".
# Author: Paul Schlosser, U.S. EPA, February-August 2017
# Translator: Dustin Kapraun, U.S. EPA, July-August 2017
#
# This script defines the name array 'inames' to be used subsequently for
# saving a current model state to initial conditions, sets baseline parameters
# for the BBDR model, and does a short simulation to set the state variables.
# Parameters should be as defined in Table 6 of the BBDR appendix.
#-----

# Load the model.
source("load_model.R")

# Set parameters to their default values as given in the ".model" file, and
# then calculate values of those parameters that depend on other parameters.
parms = initParms()

# Extract default parameter values needed for calculations below.
MWCLO4 = parms[["MWCLO4"]]

# Names of state variables for which an initial condition other than zero will
# later be used.
inames = c("Aplasma_i",
           "Arob_i",
           "AthyB_i",
           "Abound_i",
           "AT4",
           "AT3")

# Model parameters for which default values should be updated.
VMAXNISF_THY_I = 1.66e4 / (70^0.75)
CLFUI = 0.0653
VFTHY = 1.35e-4
KHCG = 0.00354          # NOTE: same as default in .model.
KDEGT4F = 1.9e-5         # 10% of value from Lumen et al. (2013).
KDEGT3F = 1.7e-4         # 10% of value from Lumen et al. (2013).
PDOSEMG_P = 0            # NOTE: same as default in .model.
PDOSEUG_I = 90           # Value used for calibration.
KABSC=20
PTSHV=1                  # NOTE: same as default in .model.
PTSHK=1                  # NOTE: same as default in .model.
HCGV=1                   # NOTE: same as default in .model.
# KMNIS_P=7.28e4 / MWCLO4 # 50th percentile of median.
# CLFUP=0.122             # 50th percentile of median.
KMNIS_P=4.86e4 / MWCLO4 # 2.5th percentile of median.

```

```

CLFUP = 0.105          # 2.5th percentile of median.

#
# To evaluate model results with 50th percentile values for KMNIS_P and CLFUP,
# comment/uncomment the relevant lines above.
#

# Update the model parameters for which values were provided above.
parms ["VmaxNISF_thy_i"] = VMAXNISF_THY_I
parms ["CLFuI"] = CLFUI
parms ["VFthy"] = VFTHY
parms ["KHCG"] = KHCG
parms ["KdegT4F"] = KDEGT4F
parms ["KdegT3F"] = KDEGT3F
parms ["Pdosemg_p"] = PDOSEMG_P
parms ["Pdoseug_i"] = PDOSEUG_I
parms ["kabsc"] = KABSC
parms ["pTSHv"] = PTSHV
parms ["pTSHk"] = PTSHK
parms ["HCGv"] = HCGV
parms ["KmNIS_p"] = KMNIS_P
parms ["CLFuP"] = CLFUP

# Recompute any parameters that may depend on the updated parameters.
parms = initParms(parms)

# Run the script "medset.R", which assigns values to some additional variables
# and updates some additional parameters in the "parms" vector.
source("medset.R")

# Run the script "non_pregnant_ss_set.R", which runs a short simulation and
# assigns values to some additional variables and some additional parameters
# in the "parms" vector. The script also sets initial conditions for some of
# the state variables in the "Y0" vector.
source("non_pregnant_ss_set.R")

# Run a simulation for 9000 hours. Use CINT from "non_pregnant_ss_set.R".
TSTOP = 9000
times = seq(from=0, to=TSTOP, by=CINT)
out = ode(Y0, times, func="derivs", parms=parms, dllname=dll_name,
           initfunc="initmod", nout=length(Outputs), outnames=Outputs)

# Use the end-of-simulation values of the state variables in "inames" as
# initial values for the next simulation. For all other state variables, use
# the default initial values.
Y0 = initStates(parms, newStates=out[dim(out)][1], inames))

# Print message that script has completed.

```

```
# cat("Script 'BBDRPreg_params.R' has completed.\n")
```

Perchlorate Dose	Iodine Intake Levels					
	FT4					
	model, median estimates					
Perchlorate Dose	50	75	100	170	300	
0	7.489559478	8.97867559	10.5874371	11.0069062	11.0592083	
0.1	7.484818897	8.96973084	10.5811674	11.0066075	11.0591364	
0.2	7.480302813	8.96106204	10.5748188	11.0063075	11.0590572	
0.3	7.475823427	8.95244487	10.5683833	11.006005	11.0589759	
0.4	7.471345869	8.94387006	10.5618662	11.0056981	11.0589003	
0.5	7.466901962	8.93535095	10.5552542	11.0053961	11.0588246	
0.6	7.462457597	8.9268855	10.5485733	11.0050908	11.0587488	
0.7	7.458032201	8.91845724	10.5417976	11.0047946	11.0586721	
0.8	7.453611375	8.91009161	10.5349477	11.0044852	11.0586	
0.9	7.449223609	8.90177174	10.528019	11.0041747	11.0585183	
1	7.44484011	8.8934992	10.5210142	11.0038657	11.0584413	
1.1	7.440471004	8.88526927	10.5139095	11.0035582	11.058355	
1.2	7.436117341	8.87709109	10.506735	11.0032489	11.0582872	
1.3	7.431769906	8.8689615	10.4994786	11.0029383	11.0582108	
1.4	7.427447675	8.86087877	10.4921509	11.0026267	11.0581322	
1.5	7.423132814	8.85283992	10.4847448	11.002318	11.0580545	
1.6	7.418830946	8.84484289	10.4772593	11.0020042	11.0579787	
1.7	7.414546964	8.8368981	10.4697023	11.001687	11.057894	
1.8	7.410275283	8.82899488	10.462068	11.0013716	11.0578253	
1.9	7.406015225	8.821133	10.4543644	11.0010546	11.0577462	
2	7.401770355	8.81332457	10.4465932	11.000744	11.0576633	
2.1	7.397537075	8.80556584	10.4387379	11.0004167	11.0575867	
2.2	7.393317252	8.79784116	10.4308235	11.0001044	11.0575115	
2.3	7.389109092	8.79015496	10.4228385	10.999784	11.0574285	
2.4	7.384916101	8.78252239	10.4152132	10.9994647	11.0573563	
2.5	7.380730286	8.77492602	10.4070921	10.9991368	11.0572716	
2.6	7.376556992	8.76737759	10.3989048	10.9988181	11.057191	
2.7	7.3724025	8.75986613	10.3906612	10.9984888	11.0571143	
2.8	7.368267312	8.7523981	10.3823505	10.9981685	11.0570402	
2.9	7.364127243	8.74496724	10.3739781	10.9978392	11.0569564	
3	7.360017246	8.73758103	10.3655363	10.9975092	11.0568736	
3.1	7.355904868	8.73024065	10.3570483	10.9971824	11.0567963	
3.2	7.351816475	8.72293524	10.3484874	10.9968487	11.056713	
3.3	7.347733143	8.71566646	10.3398753	10.9965256	11.0566325	
3.4	7.343661773	8.70844082	10.3312162	10.9961944	11.0565565	
3.5	7.339605589	8.70125508	10.3224916	10.9958601	11.0564701	
3.6	7.335558453	8.69411129	10.3137272	10.9955331	11.0563921	
3.7	7.33151638	8.68700183	10.3048969	10.9951918	11.0563139	
3.8	7.327493892	8.67992935	10.2960243	10.9948622	11.0562326	
3.9	7.32349103	8.67289877	10.2871071	10.9945276	11.0561539	
4	7.319489253	8.66590627	10.2781461	10.9941883	11.0560666	
4.1	7.315492765	8.6589486	10.2691337	10.993849	11.0559885	
4.2	7.311521655	8.65202845	10.2600793	10.9935094	11.0559057	

4.3	7.307557268	8.64514113	10.2509822	10.993169	11.0558222
4.4	7.30360481	8.63829699	10.2418507	10.9928218	11.0557449
4.5	7.299656646	8.63148495	10.232668	10.9924833	11.0556616
4.6	7.295725325	8.62471134	10.2234587	10.99214	11.0555801
4.7	7.291793832	8.61797092	10.2142122	10.9917949	11.0554937
4.8	7.287890585	8.61126418	10.2049251	10.9914431	11.0554128
4.9	7.283992319	8.60459275	10.1956106	10.9911073	11.0553249
5	7.280095339	8.59795938	10.1862687	10.99075	11.0552536
5.1	7.276221776	8.5913608	10.1768932	10.9903964	11.0551643
5.2	7.272347373	8.58479193	10.1674898	10.9900483	11.0550816
5.3	7.26848451	8.57825557	10.1580583	10.9896991	11.0550042
5.4	7.264637812	8.57175665	10.1486023	10.9893404	11.0549179
5.5	7.260810942	8.56528885	10.1391188	10.9889967	11.0548299
5.6	7.256984229	8.55885332	10.1296295	10.9886324	11.0547534
5.7	7.253157913	8.55245239	10.1200976	10.9882793	11.0546695
5.8	7.249358371	8.54606966	10.1105464	10.9879173	11.0545854
5.9	7.24555814	8.53974411	10.1009842	10.9875555	11.0544993
6	7.241766361	8.5334382	10.0914249	10.9872019	11.0544171
6.1	7.238000779	8.52716306	10.0818239	10.9868349	11.0543325
6.2	7.234223888	8.52091957	10.0722222	10.9864711	11.0542478
6.3	7.230466818	8.51470686	10.0626012	10.9861079	11.0541573
6.4	7.226726348	8.50852482	10.052968	10.9857428	11.0540719
6.5	7.222990535	8.50237796	10.0433196	10.9853754	11.0539929
6.6	7.219262368	8.49625306	10.0336673	10.9850077	11.0539075
6.7	7.215539488	8.49016026	10.0240117	10.9846362	11.0538222
6.8	7.211833863	8.48409881	10.0143497	10.9842662	11.0537341
6.9	7.208138051	8.478057	10.0046781	10.9838941	11.0536436
7	7.204448221	8.47205978	9.99499923	10.9835203	11.0535624
7.1	7.200768805	8.46609044	9.98531431	10.9831497	11.0534763
7.2	7.197092799	8.46014168	9.97563104	10.9827712	11.0533873
7.3	7.193423931	8.45422199	9.96595649	10.9823957	11.0532987
7.4	7.189770883	8.44833153	9.95627694	10.9820137	11.0532114
7.5	7.186126603	8.44246953	9.94659013	10.9816371	11.0531327
7.6	7.182496928	8.43663434	9.93691771	10.9812548	11.0530438
7.7	7.178872527	8.43082788	9.92724605	10.9808719	11.0529537
7.8	7.175250256	8.42505215	9.91757443	10.9804917	11.0528717
7.9	7.171647114	8.4192954	9.90791506	10.9801108	11.0527765
8	7.168050369	8.41355994	9.89825387	10.9797152	11.0526908
8.1	7.164461659	8.40787189	9.88860538	10.9793218	11.0526067
8.2	7.160878901	8.40219878	9.87896639	10.9789317	11.0525177
8.3	7.157307508	8.39654916	9.86933876	10.9785403	11.052427
8.4	7.153740726	8.39092482	9.85971786	10.9781519	11.0523414
8.5	7.150185413	8.3853286	9.85010574	10.977758	11.0522529
8.6	7.146636789	8.37976159	9.84050937	10.9773622	11.0521687
8.7	7.143096847	8.37421591	9.83091838	10.9769647	11.0520758
8.8	7.139565136	8.36869142	9.82135699	10.9765637	11.0519829
8.9	7.136040191	8.3631956	9.81179659	10.9761645	11.0518971

9	7.132529274	8.35772407	9.80225827	10.9757632	11.0518104
9.1	7.129024099	8.35228175	9.79273696	10.9753581	11.0517235
9.2	7.125525605	8.34685851	9.78322258	10.9749546	11.0516281
9.3	7.1220349	8.34144545	9.77373607	10.9745471	11.0515366
9.4	7.118551163	8.33608398	9.76426515	10.9741418	11.0514487
9.5	7.115078851	8.33072796	9.75480597	10.973729	11.0513572
9.6	7.111614488	8.32540026	9.74536774	10.9733146	11.0512678
9.7	7.108155346	8.32009529	9.73593743	10.9728919	11.0511764
9.8	7.104703167	8.31481667	9.72654725	10.9724864	11.0510855
9.9	7.101264596	8.30955681	9.71715689	10.9720686	11.0509965
10	7.097823716	8.30431689	9.70777784	10.9716576	11.0509057
10.1	7.094404598	8.29910576	9.69840427	10.9712408	11.0508125
10.2	7.090983713	8.29390017	9.68900716	10.9708165	11.0507247
10.3	7.08756794	8.288742	9.67941179	10.9703883	11.0506302
10.4	7.084163207	8.28359386	9.67028691	10.969965	11.0505398
10.5	7.080771075	8.27846981	9.66117955	10.969537	11.0504475
10.6	7.077387759	8.2733646	9.65212319	10.9691085	11.0503563
10.7	7.07400519	8.26828209	9.64307621	10.9686768	11.0502588
10.8	7.070631452	8.26321471	9.63407561	10.9682543	11.0501721
10.9	7.067258096	8.25817712	9.62509882	10.9678156	11.050083
11	7.063899279	8.25315673	9.61616108	10.9673757	11.0499894
11.1	7.060543803	8.24815482	9.60724975	10.9669439	11.0498962
11.2	7.057201944	8.24317401	9.59835594	10.9665027	11.0498016
11.3	7.053868079	8.23821711	9.58952419	10.9660614	11.0497104
11.4	7.050543721	8.23327621	9.58071189	10.9656187	11.0496162
11.5	7.04722096	8.22836121	9.57192958	10.9651744	11.0495254
11.6	7.043903721	8.22345885	9.56317513	10.9647257	11.0494319
11.7	7.040596724	8.21857938	9.55446194	10.9642784	11.0493382
11.8	7.037292874	8.21371996	9.54577377	10.9638281	11.0492445
11.9	7.033995301	8.20888351	9.53712391	10.9633732	11.0491482
12	7.030709794	8.2040646	9.52850903	10.9629248	11.0490561
12.1	7.027431037	8.19925693	9.51992228	10.9624618	11.0489616
12.2	7.024149459	8.19447443	9.51137361	10.962007	11.0488648
12.3	7.0208908	8.18971267	9.50285511	10.9615472	11.0487724
12.4	7.01761959	8.1849646	9.49437031	10.961083	11.0486775
12.5	7.014376344	8.18023644	9.48592028	10.9606206	11.0485659
12.6	7.011129637	8.17553045	9.47750061	10.9601519	11.0484872
12.7	7.007878425	8.17084297	9.46911598	10.9596832	11.0483917
12.8	7.004655948	8.16617046	9.46076482	10.9592084	11.0482952
12.9	7.001428978	8.16151282	9.45244718	10.9587393	11.0482005
13	6.998207016	8.15687729	9.44416451	10.9582639	11.0481028
13.1	6.994995871	8.15226183	9.43590794	10.9577866	11.0480064
13.2	6.991776804	8.14765777	9.42769687	10.9573071	11.0479157
13.3	6.988586719	8.14307683	9.41950344	10.9568233	11.0478212
13.4	6.985381434	8.13851024	9.41136195	10.9563387	11.047716
13.5	6.982203978	8.13395757	9.4032455	10.9558555	11.0476221
13.6	6.979022298	8.1294283	9.39515797	10.9553665	11.047521

13.7	6.975847126	8.1249139	9.38711303	10.9548735	11.0474281
13.8	6.97266739	8.12041509	9.379097	10.9543828	11.0473305
13.9	6.969515294	8.11593066	9.37111172	10.953887	11.0472287
14	6.966358669	8.11146796	9.36316495	10.9533812	11.0471354
14.1	6.963208002	8.10701491	9.35524888	10.9528904	11.0470382
14.2	6.960063715	8.10258129	9.34734822	10.952379	11.046935
14.3	6.956922525	8.09816662	9.3395203	10.9518825	11.046839
14.4	6.953793586	8.09376774	9.33169721	10.9513772	11.0467406
14.5	6.950659777	8.08938085	9.32392051	10.950865	11.0466408
14.6	6.94754755	8.08501414	9.31616658	10.9503598	11.0465424
14.7	6.944423107	8.08066269	9.30844501	10.9498371	11.0464475
14.8	6.941325668	8.07632513	9.30076859	10.9493157	11.0463456
14.9	6.938223451	8.0720013	9.29311006	10.9488073	11.0462449
15	6.935129138	8.06769412	9.28549295	10.9482771	11.0461483
16	6.904479375	8.02545231	9.21108835	10.9429023	11.0451426
17	6.874398615	7.98462185	9.13983383	10.9372406	11.0441147
18	6.844840595	7.94511303	9.07161452	10.9312595	11.0430757
19	6.815778802	7.90684293	9.00629335	10.9249233	11.0420147
20	6.787218318	7.86972515	8.94373172	10.9182019	11.0409343
21	6.75909875	7.83369197	8.88377627	10.9110401	11.0398425
22	6.731427585	7.79867174	8.8262881	10.9033983	11.0387129
23	6.704179662	7.76460019	8.77112501	10.8952154	11.0375882
24	6.677324499	7.7314408	8.7181463	10.8864297	11.0364188
25	6.650847035	7.69911001	8.66722175	10.8769687	11.0352338
26	6.624750158	7.66760307	8.61822904	10.866738	11.0340336
27	6.598998056	7.63684009	8.57105293	10.8556552	11.0328091
27.1	6.596439393	7.63380286	8.56642592	10.8544966	11.0326869
27.2	6.593890946	7.63077031	8.56181991	10.8533236	11.0325632
27.3	6.591341507	7.62774485	8.55723108	10.8521457	11.0324395
27.4	6.588795433	7.62472987	8.55265909	10.8509589	11.0323122
27.5	6.58625112	7.62172175	8.5481034	10.8497598	11.0321931
27.6	6.583709834	7.61872571	8.54356449	10.8485504	11.0320724
27.7	6.581172232	7.61573041	8.53904187	10.8473312	11.0319432
27.8	6.578633561	7.61273938	8.53453546	10.8461122	11.0318162
27.9	6.576114881	7.60976562	8.53004521	10.844863	11.031693
28	6.573583111	7.6067808	8.52557129	10.8436143	11.0315687
29	6.54850287	7.57741896	8.48169723	10.8304887	11.0303021
30	6.523730087	7.54869739	8.43932246	10.8161647	11.0290089
31	6.499250427	7.52058428	8.39835931	10.8004837	11.0276908
32	6.475070459	7.49305247	8.35872458	10.7832973	11.0263658
33	6.451164083	7.46607197	8.32033992	10.7644372	11.0250043
34	6.427540014	7.43961751	8.28313222	10.7437304	11.023622
35	6.404164138	7.41366328	8.2470346	10.7210094	11.0222184
36	6.381046237	7.3882	8.21198725	10.696084	11.0207873
37	6.358167384	7.36318746	8.17793283	10.6686525	11.0193261
38	6.335525304	7.33862454	8.14480967	10.6387641	11.0178462
39	6.313106465	7.31447736	8.11257315	10.6063385	11.0163396

40	6.290907947	7.29072862	8.08117478	10.5713009	11.0148036
41	6.268921735	7.26737576	8.05057146	10.5337096	11.0132405
42	6.247134269	7.24438615	8.02072338	10.4935869	11.0116502
43	6.225558998	7.22175265	7.99159054	10.4510874	11.0100234
44	6.204177204	7.19946084	7.96313681	10.4064628	11.0083771
45	6.182975691	7.17750292	7.93533423	10.3596907	11.0066926
46	6.161960506	7.15585556	7.9081424	10.3110996	11.0049876
47	6.141127519	7.13452243	7.8815552	10.2609478	11.0032399
48	6.120463321	7.11347422	7.85550874	10.2094927	11.0014589
49	6.099966856	7.09271182	7.83001457	10.1570065	10.9996482
50	6.079622108	7.0722232	7.80503664	10.1037328	10.997803
60	5.884383215	6.88049286	7.57904979	9.57518481	10.9770722
70	5.701636474	6.70801124	7.38633394	9.13769483	10.9508759
70.1	5.699857488	6.70636574	7.38452898	9.13379969	10.950573
70.2	5.698083075	6.70472309	7.38273699	9.12994185	10.9502777
70.3	5.696317945	6.70307659	7.38094324	9.12609738	10.9499775
70.4	5.694552207	6.70143523	7.37915632	9.12226111	10.9496769
70.5	5.692779964	6.6997978	7.37736451	9.11843536	10.9493725
70.6	5.691010145	6.69815302	7.3755893	9.11461914	10.949069
70.7	5.689238575	6.69652276	7.37380729	9.11081694	10.9487605
70.8	5.687479046	6.69489085	7.37202418	9.10701542	10.9484613
70.9	5.685706968	6.69324704	7.37023521	9.10323047	10.9481572
71	5.683943251	6.69161278	7.36847308	9.09944664	10.9478427
71.1	5.682184911	6.68998928	7.36669296	9.0956814	10.9475431
71.2	5.680419711	6.68836033	7.36491917	9.09191917	10.9472329
71.3	5.678662374	6.68672142	7.363149	9.08815696	10.946925
71.4	5.676903412	6.68509404	7.36139189	9.08442167	10.9466109
71.5	5.675140023	6.68347836	7.35961966	9.08069346	10.9463041
71.6	5.67338514	6.68185015	7.35786676	9.07696741	10.9459903
71.7	5.671627068	6.68023284	7.35609962	9.07325317	10.9456733
71.8	5.669868533	6.67860508	7.35433519	9.0695436	10.9453634
71.9	5.668116156	6.67698454	7.35259059	9.06584679	10.9450436
72	5.666352526	6.6753694	7.35083525	9.06216454	10.9447296
72.1	5.66459575	6.67375245	7.34908541	9.0584807	10.9444166
72.2	5.662845337	6.6721258	7.34732737	9.0548161	10.9440944
72.3	5.661097477	6.67052133	7.34558886	9.05115534	10.9437817
72.4	5.659346835	6.66889796	7.34384613	9.04750054	10.9434563
72.5	5.657599899	6.66729365	7.34209928	9.0438606	10.9431405
72.6	5.655851849	6.665678	7.34035898	9.0402223	10.9428143
72.7	5.654100353	6.66406851	7.3386129	9.03660031	10.9424915
72.8	5.652352518	6.66246087	7.33687639	9.03297998	10.9421749
72.9	5.650613982	6.66086022	7.33515064	9.02937756	10.9418487
73	5.648865657	6.65925502	7.33341144	9.02577633	10.9415234
73.1	5.647124306	6.65764094	7.33168474	9.02218766	10.9411937
73.2	5.645379951	6.65604717	7.32995685	9.01860183	10.9408663
73.3	5.643636749	6.65443653	7.32822566	9.01503075	10.9405415
73.4	5.641892193	6.65283889	7.32651154	9.01147084	10.9402122

73.5	5.640160498	6.65124418	7.32478873	9.00791014	10.9398821
73.6	5.638418852	6.6496456	7.32305823	9.00437072	10.9395508
73.7	5.636681712	6.64804348	7.32135141	9.0008327	10.9392198
73.8	5.634941151	6.64645703	7.31962747	8.99729577	10.9388854
73.9	5.633207863	6.64486448	7.31791289	8.99377488	10.9385469
74	5.631464583	6.64326382	7.31620234	8.99026296	10.9382114
74.1	5.629735928	6.64168031	7.31449094	8.98676232	10.9378802
74.2	5.628000545	6.64008848	7.31279224	8.98326364	10.9375398
74.3	5.626269163	6.63850231	7.31108038	8.97978167	10.9372018
74.4	5.62453639	6.63691526	7.30938416	8.97630263	10.9368591
74.5	5.622807502	6.63532935	7.30768171	8.97283109	10.9365218
74.6	5.621077751	6.63374396	7.30598274	8.96937363	10.9361815
74.7	5.619348674	6.63215267	7.30428525	8.96591232	10.935825
74.8	5.61762175	6.63057011	7.3025923	8.9624755	10.9354881
74.9	5.61589446	6.6289913	7.30089752	8.95903008	10.9351481
75	5.614164588	6.62740834	7.29919921	8.9556079	10.9347969
75.1	5.612438144	6.62583151	7.29752055	8.95218102	10.9344545
75.2	5.610715818	6.62426307	7.29582352	8.94877219	10.9341029
75.3	5.608994705	6.62268435	7.29414399	8.94536503	10.9337562
75.4	5.607270461	6.62111093	7.2924627	8.9419726	10.933402
75.5	5.605551933	6.61953762	7.29078331	8.93858395	10.9330539
75.6	5.603826208	6.61796412	7.28909912	8.93520681	10.9327012
75.7	5.602107958	6.61638485	7.28742511	8.93183552	10.9323439
75.8	5.600388097	6.61482791	7.28573899	8.92846664	10.9319952
75.9	5.598666781	6.61326026	7.28407307	8.92510582	10.931633
76	5.596944108	6.61168789	7.28240199	8.92176815	10.9312811
76.1	5.595238299	6.61012351	7.28073223	8.91842412	10.9309197
76.2	5.593517925	6.60855345	7.27906406	8.91509826	10.9305572
76.3	5.591809094	6.60699599	7.27739878	8.91176228	10.9301946
76.4	5.590095604	6.60543365	7.27573702	8.90845882	10.92984
76.5	5.588382938	6.60386975	7.27407343	8.90514996	10.9294687
76.6	5.58667019	6.60231262	7.27241405	8.90185018	10.9291063
76.7	5.584953591	6.6007458	7.27074967	8.8985579	10.9287406
76.8	5.583247277	6.59918929	7.26909783	8.895263	10.9283744
76.9	5.581538257	6.59763964	7.26743664	8.89199175	10.9280096
77	5.57982973	6.59608419	7.26579142	8.88872757	10.9276397
77.1	5.57812444	6.59453042	7.26413189	8.88546631	10.9272691
77.2	5.576406816	6.59297842	7.26248709	8.88220356	10.9268928
77.3	5.574703802	6.59141863	7.26084632	8.8789677	10.9265229
77.4	5.573007711	6.5898764	7.25919641	8.87572943	10.9261464
77.5	5.571300241	6.58832637	7.25755381	8.87249841	10.9257744
77.6	5.569600732	6.58678024	7.25591378	8.86927354	10.9253989
77.7	5.567899145	6.58522978	7.25427307	8.8660611	10.925021
77.8	5.566195474	6.58368931	7.25263576	8.86284069	10.9246399
77.9	5.564495062	6.58213446	7.25100243	8.8596402	10.924259
78	5.56279803	6.58059826	7.2493646	8.85644225	10.9238637
78.1	5.561099211	6.57904907	7.2477335	8.85327079	10.9234945

78.2	5.559399422	6.57751618	7.24610579	8.8500903	10.9231043
78.3	5.557709664	6.57597882	7.24447405	8.84691878	10.9227256
78.4	5.55601032	6.57442994	7.2428478	8.84375288	10.922337
78.5	5.554312717	6.57289987	7.24121195	8.84060504	10.9219484
78.6	5.552608063	6.57135792	7.23959853	8.83744486	10.9215585
78.7	5.550926145	6.56982621	7.2379669	8.83431035	10.9211631
78.8	5.549230368	6.56828801	7.23635717	8.8311807	10.9207688
78.9	5.547541925	6.56675956	7.23473785	8.82805425	10.9203785
79	5.545850695	6.56522976	7.23311782	8.8249299	10.9199794
79.1	5.544159809	6.5636973	7.23149883	8.82180994	10.9195846
79.2	5.54247059	6.56217227	7.2298854	8.81871647	10.9191879
79.3	5.540782416	6.56063964	7.22827588	8.81561917	10.9187875
79.4	5.539095992	6.55911367	7.22667518	8.81252772	10.9183919
79.5	5.537405227	6.55758332	7.22505754	8.80944423	10.9179856
79.6	5.535720817	6.55605605	7.22345612	8.80636281	10.9175806
79.7	5.534037375	6.55453886	7.22185505	8.80329277	10.9171731
79.8	5.532351846	6.55301728	7.22025501	8.80023532	10.9167729
79.9	5.530666531	6.55149351	7.21864394	8.79717466	10.9163601
80	5.528978832	6.54997533	7.21705524	8.79413091	10.9159509
90	5.364770535	6.40314606	7.06509635	8.52070801	10.8658823
100	5.207779485	6.26525819	6.92642138	8.29673301	10.7878051
110	5.057129638	6.13464874	6.79819255	8.1079094	10.6595374
120	4.91216569	6.01012109	6.67838912	7.94474083	10.4594351
130	4.77240822	5.8907232	6.56549553	7.80084269	10.1952249
140	4.637511712	5.7757346	6.45837654	7.6718214	9.90249305
150	4.507241246	5.66460767	6.35615937	7.55457606	9.61662068

	Iodine Intake Levels					
	TSH					
Model, Low Estimate	model, median estimtes					
50	50	75	100	170	300	
5.972689277	4.527379971	1.85372704	1.35650673	1.31643537	1.31087205	
5.96844032	4.545112258	1.85972704	1.35722086	1.31646696	1.31087975	
5.964217749	4.56208883	1.86560119	1.35794882	1.31649868	1.31088822	
5.960004151	4.579008728	1.87149874	1.35869179	1.31653068	1.31089692	
5.955793107	4.596002906	1.8774257	1.35944938	1.31656312	1.310905	
5.951590917	4.612949905	1.88337245	1.36022338	1.31659506	1.3109131	
5.947394468	4.629979182	1.88933989	1.36101101	1.31662734	1.31092121	
5.943202121	4.64701607	1.89533929	1.36181554	1.31665865	1.31092941	
5.939022687	4.664115639	1.9013521	1.36263482	1.31669136	1.31093713	
5.934850623	4.681166939	1.90738991	1.36346962	1.31672418	1.31094586	
5.930677636	4.698281116	1.91345119	1.36431987	1.31675684	1.31095409	
5.926516987	4.715418396	1.91953902	1.36518875	1.31678934	1.31096333	
5.922354918	4.732574107	1.92564623	1.36607287	1.31682203	1.31097058	
5.918211625	4.749784237	1.93177469	1.36697398	1.31685485	1.31097875	
5.914065965	4.766973063	1.93792526	1.36789106	1.31688778	1.31098715	
5.90993175	4.784210874	1.94409979	1.36882525	1.31692039	1.31099547	
5.90580145	4.801474911	1.95029952	1.36977697	1.31695355	1.31100357	
5.901677351	4.818744937	1.95651589	1.37074554	1.31698707	1.31101263	
5.897559772	4.836042897	1.96275682	1.37173197	1.31702039	1.31101998	
5.893443133	4.853371123	1.9690221	1.37273554	1.31705387	1.31102844	
5.889341464	4.870714625	1.97530163	1.37375631	1.31708667	1.3110373	
5.885244311	4.888087617	1.98159781	1.37479676	1.31712125	1.31104549	
5.881151428	4.905481984	1.98792296	1.37585392	1.31715423	1.31105353	
5.877065145	4.922904668	1.99427319	1.37692961	1.31718807	1.31106241	
5.872984944	4.940340658	2.00063549	1.37796543	1.31722178	1.31107013	
5.868910152	4.957822804	2.00702391	1.37907793	1.31725641	1.31107919	
5.864841903	4.975328475	2.01342817	1.38020933	1.31729006	1.31108781	
5.860779515	4.992830692	2.01985714	1.38135855	1.31732482	1.311096	
5.856721402	5.01032652	2.0263049	1.38252744	1.31735863	1.31110393	
5.852672306	5.02791811	2.03277643	1.38371555	1.3173934	1.31111289	
5.848629008	5.045456471	2.03926484	1.38492435	1.31742823	1.31112174	
5.844590647	5.063079547	2.04576854	1.38615082	1.31746273	1.31113001	
5.840556762	5.080673965	2.05229673	1.38739919	1.31749795	1.31113892	
5.836531626	5.098320589	2.0588476	1.38866661	1.31753204	1.31114752	
5.832510963	5.115989329	2.06541488	1.38995281	1.31756699	1.31115564	
5.82849607	5.133665664	2.07200101	1.39126086	1.31760226	1.31116489	
5.824487132	5.151375873	2.07860368	1.39258726	1.31763676	1.31117322	
5.820480113	5.169137216	2.0852295	1.39393631	1.31767277	1.31118158	
5.816482547	5.186885404	2.09187567	1.39530475	1.31770754	1.31119027	
5.81249383	5.204619385	2.09853711	1.39669327	1.31774283	1.31119868	
5.808508539	5.222420924	2.10521696	1.39810207	1.31777862	1.31120802	
5.804528049	5.240271335	2.11191795	1.39953269	1.31781441	1.31121637	
5.800552892	5.258080242	2.11863709	1.40098398	1.31785022	1.31122522	

5.796583273	5.275930623	2.12537856	1.40245643	1.31788612	1.31123414
5.792623291	5.293798704	2.13213179	1.40394899	1.31792273	1.31124241
5.78865751	5.311718741	2.13890727	1.40546478	1.31795842	1.31125131
5.784709646	5.329633384	2.14569829	1.40700008	1.31799462	1.31126002
5.780762487	5.347619889	2.15250971	1.40855696	1.31803099	1.31126925
5.776821027	5.365547651	2.15934067	1.41013637	1.31806807	1.3112779
5.772885248	5.3835228	2.16618911	1.41173639	1.31810348	1.31128729
5.76895469	5.401562368	2.17305175	1.4133573	1.31814113	1.31129492
5.765029584	5.419563413	2.17993155	1.41500057	1.3181784	1.31130447
5.761104774	5.437638207	2.18683341	1.41666548	1.31821508	1.3113133
5.75718603	5.455728869	2.19375409	1.41835242	1.31825188	1.31132157
5.753284705	5.473813149	2.20068792	1.42006107	1.31828967	1.31133079
5.749382399	5.491873007	2.20764123	1.42179229	1.31832588	1.3113402
5.745484515	5.510000899	2.2146124	1.4235424	1.31836426	1.31134838
5.74159141	5.528195821	2.22159852	1.42531855	1.31840146	1.31135734
5.737699561	5.546331761	2.22861722	1.42711673	1.31843959	1.31136633
5.733819276	5.564539255	2.23562513	1.42893567	1.3184777	1.31137553
5.72994377	5.582774444	2.24266328	1.43077298	1.31851494	1.31138431
5.726075363	5.600951199	2.249719	1.43263752	1.31855358	1.31139336
5.722198595	5.619250311	2.25679096	1.43452169	1.31859189	1.31140241
5.71834291	5.637520862	2.26387972	1.4364294	1.31863013	1.31141208
5.714486162	5.655777683	2.27098504	1.43835956	1.31866857	1.3114212
5.710638998	5.674078625	2.27810128	1.44031307	1.31870725	1.31142964
5.706787534	5.692408857	2.28524343	1.44228793	1.31874596	1.31143877
5.702948485	5.710779759	2.29239936	1.44428426	1.31878506	1.31144789
5.699109328	5.729131803	2.29956951	1.44630297	1.318824	1.31145729
5.695279127	5.747501251	2.30676746	1.448345	1.31886316	1.31146697
5.691446274	5.765906847	2.31396306	1.45041017	1.3189025	1.31147564
5.687622175	5.784326174	2.32117578	1.45249848	1.3189415	1.31148484
5.683815574	5.802794051	2.32841421	1.45460853	1.31898132	1.31149435
5.680003995	5.821291584	2.33566773	1.45673899	1.31902082	1.31150382
5.676197104	5.839774513	2.34293575	1.45889312	1.319061	1.31151315
5.672395587	5.858277981	2.35021885	1.46107171	1.31910062	1.31152155
5.668599897	5.876771845	2.35751872	1.46327012	1.31914083	1.31153105
5.66480772	5.89530323	2.36483258	1.46549165	1.3191811	1.31154067
5.661024182	5.913888138	2.3721575	1.46773672	1.31922109	1.31154944
5.657238731	5.932438887	2.37950807	1.4700027	1.31926114	1.3115596
5.653461422	5.951020467	2.38688117	1.47229312	1.31930273	1.31156876
5.649689154	5.969624142	2.39424268	1.47460478	1.3193441	1.31157774
5.645921351	5.988260446	2.40163413	1.4769386	1.3193851	1.31158725
5.642158699	6.006900866	2.40904421	1.47929435	1.31942624	1.31159694
5.638400251	6.025580338	2.41647027	1.48167334	1.31946707	1.31160609
5.634646581	6.044262617	2.42390819	1.4840753	1.31950847	1.31161553
5.630898225	6.062972454	2.43135609	1.48649865	1.31955006	1.31162453
5.627152601	6.081699027	2.43882417	1.48894622	1.31959183	1.31163445
5.623414064	6.10044437	2.44631239	1.49141196	1.31963397	1.31164437
5.619675315	6.119215966	2.45381026	1.49390341	1.31967591	1.31165354

5.615948288	6.137974682	2.46132337	1.49641526	1.31971806	1.3116628
5.612221693	6.15676437	2.46884457	1.49894899	1.31976062	1.31167207
5.608503855	6.175579759	2.47638753	1.50150745	1.31980301	1.31168227
5.604787084	6.194414604	2.48396456	1.50408516	1.3198458	1.31169203
5.601069857	6.213273023	2.49151715	1.50668557	1.31988836	1.31170143
5.597364584	6.232130509	2.49910985	1.50930991	1.3199317	1.3117112
5.593666087	6.251005512	2.50671011	1.51195579	1.31997522	1.31172075
5.589964788	6.269912636	2.51432547	1.51462703	1.3200196	1.31173051
5.586274498	6.288842122	2.52195041	1.51731459	1.32006216	1.31174021
5.582586059	6.307757076	2.52959558	1.52003014	1.32010602	1.31174972
5.578900784	6.326744843	2.53725902	1.5227706	1.32014916	1.31175941
5.57521865	6.345672161	2.54492743	1.52553792	1.3201929	1.31176936
5.571546468	6.364668842	2.55263482	1.52834105	1.32023743	1.31177874
5.567873583	6.383696674	2.5603188	1.53123346	1.32028236	1.31178883
5.564206744	6.402722282	2.56803452	1.53401262	1.32032678	1.31179848
5.56054561	6.421736414	2.57576075	1.53681452	1.32037168	1.31180833
5.556886034	6.440759797	2.58350509	1.53962882	1.32041663	1.31181807
5.553228705	6.459837619	2.59126143	1.54246848	1.32046191	1.31182848
5.549578596	6.478924114	2.59904102	1.54532192	1.32050622	1.31183774
5.54593556	6.498066914	2.60682106	1.54819627	1.32055223	1.31184725
5.542298209	6.517185355	2.61462059	1.55108663	1.32059835	1.31185724
5.538660426	6.536342787	2.6224374	1.55399709	1.32064363	1.3118672
5.535028099	6.555480168	2.63026715	1.55693062	1.32068989	1.31187729
5.531398099	6.574629203	2.63810503	1.55987245	1.32073615	1.31188703
5.527775339	6.593780815	2.64596328	1.56283668	1.32078255	1.31189709
5.52415705	6.612980345	2.65382582	1.5658198	1.32082912	1.31190677
5.520539663	6.632204997	2.66171361	1.56882255	1.32087614	1.31191676
5.516928661	6.651427068	2.66960988	1.57184029	1.32092302	1.31192676
5.513321801	6.670687513	2.67751893	1.57487861	1.3209702	1.31193676
5.509719163	6.689967901	2.68543564	1.57793283	1.32101786	1.31194704
5.506120657	6.709233969	2.69336859	1.58100406	1.32106484	1.31195687
5.502526658	6.728516465	2.70132798	1.58409471	1.32111334	1.31196695
5.498936245	6.747871629	2.70929052	1.58720116	1.32116096	1.31197729
5.495350593	6.767147176	2.71726316	1.59032622	1.32120913	1.31198715
5.491768159	6.786552715	2.72525748	1.59346856	1.32125773	1.31199728
5.488192361	6.80584756	2.73326275	1.59662772	1.32130615	1.31200919
5.484619688	6.825218083	2.74127483	1.5998053	1.32135522	1.31201759
5.481047596	6.844670765	2.74929959	1.60299947	1.32140429	1.31202778
5.47748118	6.864006164	2.75734287	1.60621077	1.32145398	1.31203809
5.473922889	6.883423076	2.76540465	1.60943912	1.32150308	1.31204818
5.470362852	6.902864367	2.77347208	1.61268386	1.32155284	1.31205861
5.466808501	6.922294632	2.7815484	1.61594844	1.32160278	1.3120689
5.46325873	6.941827227	2.78964851	1.61922508	1.32165295	1.31207859
5.459715454	6.961237732	2.79775158	1.62252485	1.32170356	1.31208867
5.456173875	6.980794679	2.80587277	1.62583385	1.32175425	1.31209989
5.452635773	7.000235245	2.81401268	1.62916286	1.3218048	1.31210991
5.44910263	7.019754991	2.82215406	1.63251028	1.32185594	1.3121207